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THE
PRINCIPLES AND PRACTICE
OF
MEDICAL JURISPRUDENCE

BY THE LATE

ALFRED SWAINE TAYLOR, M.D., F.R.S.

Fellow of the Royal College of Physicians of London

SIXTH EDITION

EDITED, REVISED, AND BROUGHT UP TO DATE BY

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NOTE BY THE EDITOR TO VOL. II.

◆

Vol. II. contains the sections on sexual medical jurisprudence and on toxicology, and the editor cannot let them appear without thanking Mr. Hugh Candy, B.Sc., analyst to the London Hospital, for the invaluable help he has rendered in assisting in the revision of the analytical portions of the work which are now brought up to date ; but should the reader require greater detail he will find in the Appendix references to larger manuals on the chemistry of the alkaloids and other poisons, though it must be admitted that there are many plants the poisonous properties of which still await investigation.

It may be worth remarking that the chapter on Indian Medical Jurisprudence is indexed under the word "India," as the initial word.

F. J. S.

138, Harley Street,
London, W.
1910.

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THE
PRINCIPLES AND PRACTICE
OF
MEDICAL JURISPRUDENCE.

VOLUME II.

SECTION XV.

SEXUAL MEDICAL JURISPRUDENCE, OBSTETRIC AND CRIMINAL.

Sex as a fact in identity, and the means we have for determining the sex of a person, when this is open to doubt, have already been fully discussed in Vol. I., Section IV. We have now to discuss the concrete relationships of the two sexes:—the woman as a possible wife or mother, the man as a husband and possible father, the union and the dissolution of the union of husband and wife, unlawful union of man and woman, or man with beast, the results of the union of man and woman and the methods by which these results may develop and reach the outer world, are now to be reviewed.

Primâ facie it might seem logical to divide the subject into subsections relating to the father, to the mother, and to the child; but such separation is impossible, for in many cases all three are concerned. There are, however, certain general sexual problems the solutions of which have a bearing on several special cases; these will therefore be discussed first to avoid repetition, and they will be followed by a review of the subjects with more special interests, a logical sequence of which is scarcely practicable.

The general questions are:—Is this man or woman capable of intercourse? If so, can such intercourse be fruitful? Has this woman had sexual intercourse? Is this woman pregnant? Has this woman had a child either recently or at some previous time? The bearing of these questions will become apparent as the subsequent problems are dealt with.

9 1

We shall therefore discuss our medico-legal problems in the following order:—

Sub-section A. Impotence and Sterility.
,, B. Virginity and Defloration.
,, C. Pregnancy and its duration.
,, D. Parturition or Delivery.
,, E. Divorce.
,, F. Legitimacy and Paternity.
,, G. Rape.
,, H. Abortion.
,, I. Natural birth.
,, J. Infanticide.
,, K. Unnatural offences.

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SUB-SECTION A.—IMPOTENCE AND STERILITY.

IMPOTENCE.

IMPOTENCY may be rigidly defined as "the incapability of either sex to allow or grant to the other the legitimate gratification of the sexual desire." The difference between this and sterility must be carefully borne in mind (*vide infra*), for the one may be a bar to union or a cause for divorce, the other is neither one nor the other in the eyes of the law,

The causes of impotency may be thus classified :—

General or functional, unconnected directly with the sexual organs.	Age. Illness. Emotion.	Any of which may lead to, or cause, temporary, or permanent, incapacity.
Local or organic, in direct connection with the sexual organs.	Congenital or acquired conditions.	Curable. Doubtfully curable. Incurable.

All of which groups must be noticed separately,

(1) Age as a cause of Impotency.—*In Females.*—As the woman is in effect a mere passive agent in the sexual act, there can be no limit to the oldest age at which she can be potent to allow the act, provided she be free from disease or deformity; whether she has her sexual instincts still preserved or not has nothing to do with the matter, though we have no reason to believe that mere age ever extinguishes them while life remains. As regards the youngest age, the law steps in before sixteen, causing the sexual act to be a misdemeanour or a felony (*vide* "Rape"), and therefore before sixteen potency as a possibility need not be considered; at and above sixteen it is only some other cause than age that can interfere.

In Males.—As to the age at which a well-formed male child is capable of getting an erection nothing need be said; it is a function inherent in the structure of a healthy penis, and a question on the subject cannot arise. At the other end of the scale of life records seem to show that a man of eighty is capable of becoming, and has become a (putative) father, and we have no physiological reason for believing that the mere question of "erectio penis" can ever arise on the score of age, apart from disease or accident.

(2) Illness as a cause of Impotency.—*In Females.*—Again the mere passive role played by the female prevents any discussion on this point. A woman who has a natural vagina cannot by any general disease be rendered impotent.

In Males.—It is far otherwise with the sex that plays the active part. As a general rule, diseases which do not affect the brain nor spinal cord, and which are not attended with great debility, do not prevent intercourse. On the other hand, all diseases which are attended or followed by great general debility must be held to suspend, at any rate temporary, sexual power on the part of the male: of brain and cord diseases, some are now well known to permanently destroy potency, while others may, for a time, increase it, though such usually bring on rapid impotency which is permanent.

In **acute febrile illnesses** temporary impotency is beyond any question the rule, especially so long as the fever lasts; when fever is subsiding, or has been replaced by convalescence, the power is very rapidly regained, and it is conceivable that a dishonest nurse might under such circumstances bring a charge against a patient, though the editor is not aware of such a point ever being raised in a court of law. If one such were brought to the notice of a medical jurist he could only decide the matter on general principles, degree of pyrexia, amount of debility, etc., but one has to remember how exceedingly powerful emotion may become under such circumstances.

There is one of these acute diseases, viz., **mumps,** which must receive a word of special notice. It is now well known that mumps has a special proclivity to attack the testicles (primary mumps of the testicles is reported in the *Lancet*, vol 2, 1898), and such attack is not infrequently followed by atrophy of the gland, especially in youth and adolescence. After this atrophy impotence occasionally follows, though admittedly not often: Krugelstein refers to a case in which a strong and healthy man was rendered incurably impotent after an attack of this disease (Henke's *Zeitschr.*, 1842, vol. 2, p. 354; see also Curling, *op. cit.* p. 59). Inflammation of both testicles (double orchitis) is a rare, and according to some authorities, unknown sequela of mumps.

The editor is acquainted with the case of a married medical friend whose virility, he is assured, was rather increased than diminished by the wasting of one testicle after an attack of mumps.

He cannot find any recently reported case in which definite impotence has followed.

Of **chronic general disease,** *i.e.*, of organs other than the generative or nervous ones, such as heart disease, chronic nephritis, etc., one can only say that the sexual function is so intimately allied to bodily vigour and healthy nervous energy that the integrity of these may be said to be essential for the integrity of the act; but this must not be taken to mean that we have knowledge that any of these diseases will totally prevent an *occasional* erection which may be used for its natural purpose, though they will undoubtedly diminish a man's average frequency of potency. Habits of drunkenness, the abuse of narcotics, or other drugs, may undoubtedly act in a similar manner, and it is possible to conceive that very determined bad habits of this nature might result in impotency, absolutely permanent while the habit lasted, but occasionally disappearing with discontinuance of the habit.

The editor has for some years known a patient, who at one time suffered from tubercular peritonitis, and now consults him about the intense agony that he suffers after every act of copulation; this agony is so great that he actually submitted to an exploratory laparotomy to see if the cause could be removed. The operation failed in its purpose, and the patient, though now physically and emotionally potent enough, dreads the pain so much that there is a danger of his becoming practically impotent.

He is in 1910 still potent, but rarely indulges in connection owing to the pain, which is unaltered in character.

Of **mental and other brain diseases, and of affections of the spinal cord,** many are now well known to have an effect upon potency in the male subject. Excessive sexual activity is well known to be a feature in many forms of mental alienation in their early stages, though this is usually followed by absolute and permanent impotency; perhaps the most typical of such diseases is that known as general paralysis of the insane, one or two striking examples of which (with this symptom) have come under the editor's own personal cognisance.

Tabes dorsalis, or locomotor ataxy, is perhaps the commonest of the spinal cord affections to have the sexual powers interfered with in one direction or the other.

In 1893 and again in 1898 the editor was consulted by patients (one on each occasion) who wished to marry, but were deterred from taking that step without advice, by the fact that neither of them could get an erection; in both of them there was abundant evidence that they were suffering from locomotor ataxia (one was later reported to have committed suicide through distress at his condition). In the case of *Bagot* v. *Bagot* (Irish Probate Court, 1871), the husband had this disease, and a mass of conflicting medical evidence resulted.

It must be emphatically stated that although the above two cases now stand on record, impotency is not a universal and inevitable effect of this disease. Byron Bramwell ("Dis. of Sp. Cord," p. 140) states that occasionally there is seen in locomotor ataxy the reverse effect, viz., satyriasis or excessive sexual inclination. Priapism or painful persistent erections of the penis totally unassociated with any sexual desire or even potency (from pain), which occurs in some lesions, must not be confounded with a potent condition. The question may be further studied in Bramwell's works, pp. 139 and 140, where physiological explanations are offered, which would form a satisfactory basis for attempting to estimate the medical evidence that might be offered in such a case, since no doubt in a case of myelitis with recovery, potency or impotency would depend upon the situation of the lesion.

These cases of alleged impotency from corporeal disease, when they require to be elucidated by medical evidence, create great difficulty.

In *Legge* v. *Edmunds* (Vice-Chan. Court, 1854-5) a question arose respecting the legitimacy of a child conceived during wedlock, but born four months after the death of the husband. In presumption of law, the child was legitimate, because husband and wife were at the time living together, and conception and birth were, as to date, in accordance with the ordinary rules. Two months preceding the supposed date of conception, the husband, a man of intemperate habits, was seized with paralysis (*hemiplegia*) accompanied by coma, and he lost the use of the right side of his body. In about a month he partially recovered, but the paralysis never left him. A month later he was attacked with general dropsy and disease of the liver, and he died five months after the supposed date of conception, and four months before the birth of the child. A year after the death of the husband, the widow married the defendant, the alleged adulterer, and had by him four children; but for eight years preceding the death of her first husband this woman had borne no child, and it was only when her intimacy with the alleged adulterer commenced, and during her husband's illness, that she became pregnant.

The question submitted to Carpenter and the author on this state of facts was—Was it possible or probable that the husband could have begotten the child in the diseased condition in which he was represented to have been at the date of conception? The opinion given was that it was possible, because there was opportunity of access; and sexual power, if lost by the attack of paralysis, might have returned at a time corresponding to this date; but they considered it to be in the highest degree improbable. It was alleged that diseases of this kind tended to suspend sexual power, that in this particular instance the effect would be aggravated by the intemperate habits of the husband, and the general exhaustion and debility under which he was proved to be labouring. Further, the non-procreation of children during the eight years that he was married and in constant habits of intercourse with his wife was clearly not owing to sterility or incapacity on her part, because she had borne four children after her marriage with the defendant: it could, therefore, in their opinion, be assigned only to impotency or incapacity in her first husband. The general conclusion which they drew from the facts laid before them was that the husband at the time was impotent, and incapable of begetting a child. Evidence to this effect was given by them in the inquiry subsequently directed by the Vice-Chancellor. At the same time, they did not feel justified in asserting that prolific intercourse on the part of the husband was actually impossible. Guy and Semple gave evidence on the part of the defendants, to the effect that there was no proof of impotency in the husband, and that a man labouring under such an illness as that from which he was stated to have suffered would still be physically capable of procreating children. The evidence regarding the precise bodily condition of the husband about the date of conception was conflicting; and the Vice-Chancellor decided in favour of the defendants, that the child was the child of the husband, and was entitled to the estate which the plaintiffs, the heirs of the husband, sought to recover from the defendant and the widow who had married him. There was no evidence from parental likeness, for the child through whom the claim arose had died some time before proceedings were taken. The legal presumption of legitimacy by wedlock and possible access was too strong to be rebutted by medical opinions. [I think a different verdict would now be given.—Ed.]

It is very rare, if not unknown, for these affections of the spinal cord to have an effect upon the testicles, but should they do so and cause also motor paralysis, there can be no doubt of impotency; but Curling quotes a case from a foreign writer, in which, under paralysis (*paraplegia*) of some years' duration, a man retained sufficient sexual power to have prolific intercourse. When the paralytic person is advanced in age, it is highly probable that he is impotent. In 1857 a case was referred to the author, for his opinion on the capacity for intercourse under the following circumstances:—

A woman required an order of affiliation on the putative father of her bastard child. She was a widow, and the illicit connection took place about two months before her husband's death. The husband was at the time eighty-four years of age; he was bedridden, and for many weeks before his death he could not move in his bed, and was unable to pass his urine without assistance.

The medical opinion of those who examined him was that he was impotent from physical infirmity, and in this opinion the author concurred; stating, however, that unless the male organs were diseased or destroyed, it could not be said that intercourse was impossible. It was, however, wholly improbable that the husband could have been the father of the child.

Blows on the head or spine, by affecting the brain and spinal marrow, may produce impotency. Several cases of impotency from this cause are related by Curling (*op. cit.* p. 363). It has been noticed that blows on the under and back part of the head, in the region of the cerebellum, have been followed by loss of sexual power on recovery. Sometimes this is temporary; but at other times, when there is wasting of the testicles, it is permanent and irremediable.

(3) Emotion as a Cause of Impotency.—*In the Female.*—Again, from her passive role, emotion can hardly be said to be a definite cause of genuine and ineradicable impotency, but at the same time the profession does recognise that the emotions in a female (especially virgins) may rise to such a height as to constitute practical impotency. "The slightest approach evokes a paroxysm of dread and of consequent resistance, which defies all efforts" (Dixon Mann). Local causes may be here at work, which may be amenable to treatment. Fruitful intercourse, under anæsthesia, might be followed by relief.

In the Male.—Emotion is an exceedingly common cause of temporary impotence, as all medical men can testify; and in a few exceptional cases is reported to have caused permanent impotency as regards one particular female. Tact and possibly a slight exhibition of drugs will, however, usually overcome this form of impotency. The sexual desire, like other animal passions, is subject to great variation; and there are instances on record in which men, otherwise healthy-looking and healthily formed, have experienced no desires of this kind. They are in a state of natural impotency—a condition which the canon law designates as "frigidity of constitution." This is not to be discovered by examination, but rather from their own admission. Under this head we may class hypochondriacal affections.

Local Causes for Impotency.—

Congenital Conditions.

In the male	Non-development of penis.
	Ill-development of penis.
	Penis adherent to scrotum.
	Duplex organs (?).
In the female	Absent vagina.
	Vagina ill-developed; too small.
	Vagina occluded by intra-uterine disease (?).

Acquired Conditions.

In the male	Disease of penis	Simple.
		Malignant.
	Amputation of penis	Intention.
		Accident.
	Accident to penis.	
	Disease of testicles and ducts.	
	Excision of testicles.	
	Accidents to testicles.	

Acquired Conditions.—contd.

In the female	Disease of walls Adhesions of walls Tough hymen Tumours bulging in the walls.	Causing occlusion of vagina or so much pain as to amount to occlusion.

Some of these conditions are obviously incurable; others may possibly be removable by time, etc., and some, again, by the art of the surgeon.

(A) Deformities or Defects of Development.—Congenital Conditions: (*a*) *In Males.*—In some instances there is an arrest of development in the external organs: and with this there is generally an absence of sexual desire. Farr met with a case of a man, aged forty-two, in whom the sexual organs remained undeveloped and in an infantile state. There was some difficulty in finding the testicles, in consequence of their small size. On examining the contents of the glands microscopically, no spermatozoa were detected. This person's voice was effeminate, and he was devoid of hair on the chin and pubes (*Med. Gaz.*, 40, 857). It is not, however, always to be inferred that a male with imperfectly developed organs is incurably impotent. The following case is quoted by Curling:—

> A gentleman, aged twenty-six, consulted Wilson on the propriety of his entering into marriage. His penis and testicles but little exceeded in size those of a youth of eight years of age, and he had never, until this acquaintance with his intended wife, felt the desire of sexual intercourse. He married, and became the father of a family; and at the age of twenty-eight the organs had attained the full development of those of an adult (*op. cit.*, p. 95).

Even the presence of two or three penes, according to Mende, is no bar to the exercise of sexual power, provided one possesses the normal characters of the male organ. This author refers to cases of duplex organs ("Ausführl. Handb. d. Gerichtl. Med., 4, 337). One of these sexual monsters, a youth with two distinct penes, was exhibited in London some years since. He could exercise his functions with either organ, but there was only one testicle to each penis.

An adherent penis is a congenital condition, and as such it may not only in itself be a cause of impotency, but may have led to a non-development (or growth) of the organ, so that, although the condition itself may be curable by operation, it is possible that the loosened organ may be still of little use.

The penis finally may be (for practical purposes) completely absent, owing to imperfect development. Such cases are extremely rare. Incurable impotence is, of course, a result, and probably sterility also, though such is not an absolute necessity.

(*b*) *In Females.*—The vagina in females is sometimes absent, a condition which has (*vide* Sect. IV.) been known to lead to a curious result, viz., sexual intercourse by means of the urethra. Such a result could not *à priori* be expected, and the condition must be called incurable impotence. When the vagina is present, but merely too small owing to absence of growth, such a condition is commonly curable by surgical treatment.

(B) Disease and Accident as Causes of Impotency.—Acquired Conditions: (*a*) *In the Male.*—(i.) *Of the Penis.*—Temporary impotency may be caused by any acute disease of the penis, *e.g.*, the chordee of gonorrhœa, sores on the glands or foreskin, etc. These need not be further considered; they come under the head of general surgery: more chronic disease, such as epithelioma, could only come before a medical jurist when it had lasted through such a period as to raise a question of the legitimacy of a given child, but each case must be judged on its merits, it is impossible to speak about general rules. The editor met with a curious case in 1879, in which a man of sixty-five had broken his penis by too vigorous efforts at connection; he recovered perfectly, and expressed a determination to be more careful in the future. Complete amputation of the penis, whether accidental, suicidal, or homicidal, is obvious in its results, though the amount amputated in incomplete operations might leave a doubt (*vide* case "Med. Leg. Soc.'s Trans.," vol. 2).

(ii.) *Of the Testicles.*—It is rather extraordinary the amount of disease that may exist in one or even both testicles without destroying either sexual appetite or power, and even complete destruction or removal does not *at once* destroy the power of connection, though it undoubtedly does so after a time. For further information surgical manuals must be consulted. Impotency from personal abuse is very doubtful, and depends more on mental emotion (shame) than anything. The value of injections of orchitic fluid is still doubtful and *sub judice*.

(*b*) *In the Female.*—Vaginal diphtheria or ulcers of any sort may, on healing, lead to a condition of occluded vagina, and that, in some cases of a permanent and irremediable character. In elderly females a disease known as kraurosis vulvæ has been found to produce the same result. Conditions of toughness of the hymen are distinctly curable, and so are many cases of tumours, fibroids, cysts, etc., which may block the canal; prolapse of uterus, vaginal hernia, may be curable; but, again, we must refer the reader to manuals of gynæcology.

STERILITY.

This, in strict definition, is simply the opposite of fertility, *i.e.*, is entirely a matter of procreating children, and as such is absolutely independent of whether or not impotence be present. The distinction between impotence and sterility is very important, and must be clearly borne in mind. Sterility by itself offers no ground for a divorce, while impotence may become a just ground. Either a man or a woman may be sterile and yet not impotent, and impotent yet not sterile. As with impotency, we may classify the causes of sterility thus:—

General or functional, unconnected directly with the sexual organs	Age. Surroundings, including illness, emotion, and unknown conditions.	May lead to or cause temporary or permanent sterility.
Local or organic, in direct connection with the sexual organs.	Congenital or acquired conditions.	Curable. Doubtfully curable. Incurable.

(A) Age in Relation to Sterility.

In the Male.—Puberty.—Until the period of puberty the testicles are small, and they increase very little in size in proportion to other parts. Curling found that the size of the seminal tubes differed but little at the ages of eighteen months and eight years. Fertile sexual function in the male depends entirely on the proper development of these organs; but the age at which fertility appears differs in different persons. The age of puberty in a healthy male in this country varies from fourteen to seventeen years; its appearance is, however, affected by climate, constitution, and the moral circumstances under which the individual is placed, and in some cases it is not fully developed until the age of twenty-one.

The seminal secretion in the male is not prolific until it contains those peculiar filiform bodies, which are known under the name of *spermatozoa*. All agree that they are normal and essential constituents of the healthy and prolific seminal fluid. They are peculiar to the spermatic secretion, and, in healthy males, are always present in it after the age of puberty. In cases in which they are absent, from whatever cause, it is a fair inference that the person is sterile, or that he has lost the power of procreation ("Obs. on Sterility in Man," by T. B. Curling, 1864). In this pamphlet one case is related in which a man, æt. 42, who was married, and whose wife had borne a son then eight years of age, had died after four days' illness from strangulated hernia. The testicles, from the fact of their being found in the inguinal canals, were examined, and no spermatozoa were discovered in either of them. But these may have been formerly present, although absent at the time of examination, as the child begotten was then eight years of age. During this long interval the secretion may have undergone a change, and have become unprolific.

There is no need in a modern work to enter into the old discussions as to the agency of spermatozoa in fecundation; it suffices to say that so long as spermatozoa can show movement they are alive and capable (presumably) of fertilising an ovum; when they lose movement they are dead (or speedily die), and incapable of so fertilising an ovum.

It is certain, then, that a male is incapable of procreating until spermatozoa have appeared in the seminal secretion, and that he loses this power when they disappear. The *age* at which they are formed varies with all the causes that affect puberty. Curling found them in the secretion of a boy aged eighteen, but there is no doubt that in many cases they appear much earlier than this, for sexual propensities are often strongly developed in children, and they may be prolific at an early age. Rüttel met with a case in which a girl at the age of fourteen became pregnant by a boy of the same age (Henke's *Zeitschr. der S. A.*, 1844, p. 249), and in the *B. M. J.* for April 23rd, 1887, the following case is reported:—

"*Early Paternity.*—M.D. writes: A case has recently come under my notice of sufficient physiological and medico-legal interest to deserve notice. A young woman was sent to me for examination, and it was evident she was pregnant. She confessed it, and was brought face to face with her paramour; they both confessed that the woman had led him astray, and allowed him to have intercourse at least a dozen times. The present age of the father is thirteen years and three or four months, and as quickening had taken place at the time of my examination of the woman, the lad could have scarcely attained the full age of thirteen at the time the intercourse took place. The boy, I may say, is well developed as regards the generative organs, but is this not an unusually early age for the development of the procreative functions?"

This is the earliest age at which, in a temperate climate, the procreative power has been reported to have appeared in the male.

Cases of unusually early development of the external appearances (pubic hair, large penis) of puberty are met with from time to time.

Thus Stone refers to one such in a boy of four (*Amer. Jour. Med. Sc.*, October, 1852), and the editor saw a boy of five (shown by Mr. Hugh Lett at the London Hospital in 1907) with the pubic hair and penis of an adult, and others have been reported from time to time in medical journals. The editor can find no record of fertility in such cases, and he would be inclined *à priori* to doubt fertility, though of potency there can be little doubt.

In a case of contested legitimacy or affiliation, this question regarding the age at which a procreative power appears in the male may have an important bearing on the issue. Thus the person may be so *young* as to render it impossible that he should be the father of a child imputed to him. The rule for a medical man to follow on these occasions is this: not to regard the mere *age* of the youth, whether he is above or below the average age of puberty, but to observe whether the sexual organs are fully developed, and whether there are about him any of the marks of virility, indicated by muscular development, the growth of a beard, and a change in his voice. If these signs are present, whatever may be his age, there is strong reason to suppose that the sexual functions are developed. We occasionally hear of instances of extraordinary precocity, but the development of sexual power is generally accompanied by other well-marked changes in the person. Sometimes these changes do not make their appearance until after the age of twenty-one.

On the other hand it may be a question at what time the procreative power disappears in a male. That impotency may possibly occur as one of the natural consequences of *advanced age* is undoubted; but this, as we know, forms no legal impediment to the marriage of parties, however old. The legal presumption is, that the generative faculty does not disappear through age; and if this be alleged, and legitimacy disputed on this ground, it must be satisfactorily proved by those who would benefit by the allegation. This amounts almost to an impossibility, because it is well known that there is no fixed age at which the sexual functions cease either in the male or female; and individuals, at least of the male sex, who had passed the ages of sixty, seventy, and even eighty years, have been known to be capable of fruitful intercourse. Duplay believes, from his anatomical observations on the bodies of aged persons, that the causes of sterility in advanced age are to be found rather in the excretory than in the secretory apparatus. Thus he has met with obliterations in the canal of the epididymis, the vas deferens, and the vesiculæ, the effect of which is to prevent the accumulation or the passage of the seminal fluid (*Med. Times and Gaz.*, 1856, 1, p. 650). *Per contra*, he found spermatozoa in the liquid taken from the testicles of a man upwards of seventy years of age, and on one occasion in the testicles of a person aged eighty-seven. Wagner states that they are to be found in the secretions of men between seventy and eighty years of age. Other cases of a similar kind are recorded by Debrou (*Gaz. Hebdom.*, January 4th, 1861, p. 6). Facts tend to render it highly probable that the fecundating power may be retained by the male up to the age of 100. Dieu has given the results of 105 autopsies of men between the ages of sixty-four and ninety-seven. In 61 per cent. no spermatozoa were found. Four of the cases were nonogenarians: of these none had spermatozoa (*Amer. Jour. Med. Sc.*, April, 1868, p. 523). According to Duplay, the seminal fluid of old men contains spermatozoa even when they are beyond the age for fecundation (*Med. Times and Gaz.*, 1853, 1, p. 581); but he does not state the circumstances which enabled him to arrive at this conclusion.

Lord Erskine, in the Banbury Peerage claim, quoted the case of Sir Stephen Fox, who was married at seventy-seven, and had four children, the last when he was eighty-one. Schneider met with a case in which a man of seventy-one had a child by his wife, who was only seventeen (Henke's *Zeitschr.*, 1842, 2, 165). Rüttel mentions the case of a man who, at the age of ninety-two years, married and had two children by his wife. The retention of procreative power became a question in the case of *Johnson* v. *Johnson* (Vice-Chanc. Court, January, 1871).

In 1845, Mr. Johnson, being then upwards of sixty years of age, married his second wife, a girl of sixteen. She obtained great influence over him, and induced him to quarrel with the children of his first marriage, the plaintiffs in the suit. In 1861, when Mr. Johnson was upwards of seventy-seven years old, Mrs. Johnson bore a child, which died. In 1862 and 1865 two more children were born, who were the defendants in the suit. As Mr. Johnson would have been of the age of seventy-eight and eighty-one at the time these children were born, it was alleged that they could not have been begotten by him and were not his children.

Malins, V.-C., declined to make any order. He thought it hopeless for the plaintiffs to attempt to make out that the children of Mrs. Johnson, *born while* her husband was living with her, and designated by him *as his* children in his will, were not his children. It was, however, a very significant fact in the case, that the testator lived fifteen years with his young wife without having had any children, and that they rather rapidly appeared in succession when he was between seventy-seven and eighty-one years old. When the procreative power even appears to be lost at an advanced age, the stimulus for intercourse is often very great, associated with and probably called into activity by, an enlarged prostate. In all cases of prolonged virility it is observed that the bodily and mental powers are also retained in an extraordinary degree, showing the close relation which exists between the sexual function and corporeal development, even to the last period of life.

Plumbe v. *Neild*, 102 L. T. 155, medical evidence, that a man, æt. 72, was unable to procreate children, refused.

The English law on this subject was clearly laid down in the Banbury Peerage case (brought before the House of Lords in 1806).

Lord and Lady Banbury had been married twenty-one years, without having had issue, when he died at the age of eighty-five years. The peerage was claimed by the descendants of an individual who called himself the son of Lord Banbury; but, in fact, it was alleged that he was the son of Lady Banbury by an adulterer, during her husband's life. According to the evidence, Lord Banbury did not appear to have been aware of his existence, and the child had always been known by another name (Amos, *Med. Gaz.*, vol. 7, p. 741). One of the grounds upon which the legitimacy of the descent of the claimant was contested, was that the deceased nobleman had become impotent through *age;* but it was argued by Sir S. Romilly that the law placed no limit on the powers and faculties of men in this respect. The assumed impotency of the husband on the ground of age could not be admitted as a proof of the illegitimacy of the alleged offspring. In 1813 the House decided against the claim, but not on the ground of impotency from age in the husband. It was proved that Lord Banbury was hale and hearty at the time of his death; but the moral circumstances of the case, especially the *concealment* of the birth of the child from the husband, were considered sufficient to prove that the child through whom the claim was made was not the offspring of Lord Banbury. This case incontestably proves that there may be capacity of intercourse and possibility of access on the part of the husband, yet every species of moral evidence will be admitted to rebut the legal presumption of legitimacy when there are reasonable grounds for disputing it. Romilly remarked, in reference to the retention of procreative power in advanced age, that the liberality of the English law on this subject was excessive; for there was no age, from *seven* upwards, at which a man has been denied the power of procreating children.

Males at the age of fourteen, and females at the age of twelve, are legally competent to contract marriage.

In the Female.—Puberty.—In the form of a syllogism there can be no doubt that the following terms represent the relationship between female fertility and menstruation :—

To be fertile a woman must possess an ovary (uterus, etc.).

This ovary must contain living ova capable of development.

These ova attain a certain stage of development, which we may designate ripeness, at successive periods of time.

A ripe ovum ruptures its capsule and reaches the uterus.

It is impregnated by a spermatozoon in the uterus.

(To these last two statements certain exceptions occur, proved by the facts of the various forms of ectopic gestation, but these do not invalidate the general truth of the statements.)

The escape of a ripe ovum is generally associated with certain phenomena, known collectively as menstrual molimina.

The prominent external molimen is an escape of blood from the vagina, which escape is ordinarily spoken of as menstruation.

The escape takes place periodically and commonly every twenty-eight days; occasionally at longer or shorter intervals.

Facts prove to a demonstration that the last three statements have exceptions, and as medical jurisprudence is largely concerned with exceptions to rules the matter must be considered under the following heads:

1. When does menstruation commence?
2. Must menstruation precede pregnancy?
3. What is the earliest age for pregnancy?
4. When does menstruation cease?
5. Can a woman become pregnant after the menopause?
6. What is the oldest recorded age for pregnancy, apart from the question of menopause?

1. **When does Menstruation Commence?**—The menstrual function is commonly established in females in this climate between the ages of *fourteen* and *sixteen*; but it may occur much earlier—indeed, in some rare instances, a discharge resembling the menstrual has been known to occur in mere infants. The occasional appearance of the menstrual flux at an early age does not necessarily imply that in other respects the female attains the development of puberty nor any undue precocity of the child as to sexual instincts. In other cases its appearance has been protracted to a much later period. Perhaps, in this country, the most frequent age for the commencement of menstruation may be taken at fifteen years. It is liable to be accelerated in its appearance by certain moral and physical conditions under which a girl may be placed. In India and other warm climates it is commonly asserted that puberty occurs very early, but the recent experience of European female doctors in India shows, however, that the maturity of women by no means occurs so early as has been hitherto supposed among Eastern women.

Instances of premature menstruation in the female are numerous, and are far more common than precocious puberty in the male sex. Whitmore met with a case of a female child, who, from a *few days* after her birth, menstruated regularly, at periods of three weeks and two or three days, until she had attained the age of four years, when she died. On inspection after death she appeared like a much older girl. The breasts were unusually large, and the female organs and lower limbs were considerably developed (*North. Jour. of Med.*, July, 1845, p. 70). For similar cases, *vide B. M. J.*, 1, 1901, 1 and 2, 1902. Another case of a child aged three years is reported (*Lancet*, January 29th, 1848, p. 137). The breasts were as healthily developed as in an adult of twenty years, and the sexual organs were also as much developed as in a girl at the age of puberty. It was observed that this child, who had been regularly menstruating for twelve months, had the appearance of a little old woman. Flugel reported the case of a female child who died at the age of *five* years and six months, and who had attained the height of five feet and a proportionate development of the body throughout. When six months old she had cut all the incisor teeth, and when nine months, all the molars. When she had reached the eighteenth month the menses first made their appearance, and from that time occured with great regularity. The hair of the head was long, the breasts prominent, the external genitals well-developed but without hair. The pelvis was capacious. The intellectual powers were not more advanced than usual (*Amer. Jour. Med. Sc.*, July, 1872, p. 245).

On the other hand, cases of delayed menstruation are from time to time reported. Camps found that it had not appeared in a married woman, æt. 30, who had borne no children (*Med. Gaz.*, vol. 32, p. 409).

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Another case is mentioned in the same volume, where it appeared for the first time at the age of forty-seven.

2. **Must Menstruation precede Pregnancy?**—The editor is unable to find any case in which it is definitely stated that a woman who had never at any time had any menstrual molimina whatever, had become pregnant; but at the same time the possibility of such taking place is generally admitted, inasmuch as it is by no means established what is the precise and exact relationship between the mere external escape of blood and the escape of a ripe ovum ("Menstruation and Its Disorders," by A. E. Giles, 1901). Provided, on the other hand, that some molimina have at some time or other been shown, there can be no question that a temporary condition of amenorrhœa is no bar whatever to conception.

3. **What is the Earliest Age for Pregnancy to Occur?**—It is commonly assumed that as soon as menstruation appears a woman may be considered to have acquired procreative power. It is, however, obvious that in the case of quite young babies such a view is untenable, and even in the cases of young girls it is not common to hear of them becoming impregnated. A case is mentioned by Beck, of a girl menstruating at one year; she became pregnant, and was delivered of a child when little more than *ten years* old. Walker met with a case in which the menstrual function was established at the age of eleven and a half years, and the patient was delivered of a living child when only twelve years and eight months old (*Amer. Jour. Med. Sc.*, October, 1846, p. 547). In another, observed by Rüttel, a female of the age of *fourteen* became pregnant by a boy of the same age. He also quotes three other cases, where one girl of the age of *nine*, and two at the age of *thirteen*, became pregnant (*loc. cit.*). Wilson met with an instance in which a girl at the age of thirteen years and six months gave birth to a full-grown child; conception must have taken place when she was twelve years and nine months old (*Edin. Med. Jour.*, October, 1861, p. 332). See also Casper's *Vierteljahrsschr.*, January, 1863, p. 180). Robertson mentions the case of a factory-girl who became pregnant in the eleventh year of her age. A case came before a magistrate in 1871, in which a girl under thirteen was found to be pregnant. It appeared from the evidence that impregnation must have taken place when the girl was twelve years and three months old.

A man, æt. 45, was prosecuted (*R.* v. *Chattaway*, Coventry Sum. Ass., 1838) for a misdemeanour in having had carnal knowledge of a girl named Sprason, then between the ages of ten and twelve years. When intercourse was first had, the girl was *eleven years and eight months old*; it was repeated several times subsequently: and when the prosecutrix gave her evidence in Court it appeared from the statement of the mother that she was in the last month of her pregnancy: she was then not quite twelve years and six months old. Menstruation had commenced in this girl at the age of *ten years and two months*, and had continued regularly up to December, 1847, which was about the time when she first had intercourse with the prisoner. It appeared that she was a factory-girl; and to the heat, confinement, and association with males, to which girls are subjected in this employment, may be referred the early commencement of puberty. The prisoner was convicted (*Med. Gaz.*, vol. 42, p. 751).

Dixon Mann ("For. Med.," p. 86) gives to Dodd the eminence of reporting the earliest age for pregnancy: "A girl began to menstruate at twelve months, became pregnant when eight years and ten months old, and was delivered of a living child, which weighed seven pounds." This will probably remain a record, unless the one mentioned in the *B. M. J.*, July 2nd, 1904, beats it; but this is founded only on a newspaper report (*vide* also *Lancet*, 1, 1903, p. 1822).

4. **When does Menstruation cease (Climacteric or Menopause[1]) ?**—The average age at which this function ceases in women is from forty to fifty years: but as it may commence early, so it may continue late in life. In one case it has been known to cease at the age of twenty-three, and in other instances it has continued to the age of sixty-six and even of seventy-five years (Whitehead, *op. cit.*, pp. 145 *et seq.*). Out of many cases collected by Hogg, the earliest age at which menstruation ceased was twenty-three, the initial period having been sixteen years. In one woman it ceased at thirty-four, and in two at fifty-three, but in the greatest number (nine) it ceased at forty-seven (*Med. Times and Gaz.*, 1871, 2, p. 555). Royle describes three cases, in two of which menstruation continued up to the age of sixty-seven (*Lancet*, 1860, 2, p. 527). Thomas met with a case in which a woman had ceased to menstruate at the age of forty-five, but the discharge suddenly reappeared after an attack of illness when she had reached the age of sixty-nine. The discharge appeared several times, but not with monthly periodicity. It seems that her mother and sister had also menstruated at the ages of sixty-nine and sixty years (*Med. Times and Gaz.*, 1852, 2, p. 148). In a case which occurred to Capuron, it continued beyond the age of sixty (*op. cit.*, p. 98); but a more remarkable case, both of late menstruation and late pregnancy, is quoted by Orfila from Bernstein. A woman, in whom the function appeared at twenty, menstruated until her ninety-ninth year. Her first child was born when she was forty-seven, and her seventh and last when she was sixty years old ("Méd. Lég." 4ème éd., 1848, 1, 257; see also Briand, "Man. de Méd. Lég.," 1846, p. 137). Other cases are recorded on good authority.

Whitehead communicated to the *Lancet*, 1886, the following facts. He was called to a lady, æt. 77, suffering from uterine hæmorrhage. Upon inquiry, he found that she had menstruated monthly up to the time at which he saw her. The discharge lasted from four to five days, and had then left her; but on this occasion it had been very profuse. She was restored by the usual remedies. Other cases are reported (*Amer. Jour. Med. Sc.*, July, 1845, p. 172). In one of these, a nun, the menses ceased at fifty-two; at the age of sixty-two they reappeared and so continued regularly, until she was last seen at the age of seventy-three. In another instance, a nun aged ninety had regularly menstruated from the age of fifteen to fifty-two years. The menses then ceased, but reappeared at the age of sixty, without pain, and occurred regularly every month after that date. Her health has been good throughout.

While it may be just to accept these cases of menstruation prolonged much beyond the average, it must not be forgotten that discharges of blood from the vagina, and that even of a periodical nature, may be due to disease of the parts; polypi, malignant disease, and others, may certainly cause such.

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[1] An amusing illustration of the ignorance of some insurance offices will be found in the *Lancet*, January 4th, 1902, wherein a legal firm ask where a lady who wished to be insured could get her menopause established or filed!

From these facts, it is clear that it is impossible to fix the age of a woman by the period at which this "change of life" occurs. At the best, it can only be an average of a certain number of instances. This question arose (*Clark* v. *Tatom*, Kingston Lent Ass., 1848), in reference to the identity of a woman, through whom property was claimed by the husband, who was the plaintiff in the action.

The marriage had taken place in 1794; the parties separated in 1809; and the plaintiff's wife, as it was alleged, died in 1843, when, by direction of the defendant, the age of fifty-five was put upon the lid of the coffin. A medical gentleman who attended her in 1841, deposed that, from being then in her menstrual climacteric, he should consider her not to have been more than fifty at that time. He stated that the general period for the cessation of menstruation was forty-four; it was rarely protracted to the age of fifty. On this assumption, it was impossible that the deceased could have been the plaintiff's wife, because at the time of the alleged marriage she would have been only *three years old*. On the part of the plaintiff, direct evidence was given to show that the deceased woman was his wife; and it therefore remains to be considered whether the adverse medical opinion is or is not consistent with medical experience.

It is obvious, from the cases above quoted, that menstruation may continue to sixty-six or seventy years of age, and that this may have been an exceptional instance. The plaintiff had a clear right to this medical presumption in his favour; and, admitting that his wife was seventeen at her marriage, she would have been menstruating in her sixty-sixth year. Hence it is evident that the medical facts of the case were consistent with the evidence adduced on the part of the plaintiff. At the trial those well-known exceptional cases of menstruation beyond the fiftieth year were not even referred to: nevertheless the jury returned a verdict in favour of the plaintiff.

5. **Is it possible for a Woman to become Pregnant after Menstruation has Ceased?**—It is commonly asserted and believed that, after the cessation of menstruation, a woman is sterile. This is doubtless the general rule; but in a medico-legal view it is necessary to take notice of the exceptions. Pearson communicated to the *Lancet* the case of a lady aged forty-four, who up to September, 1836, had given birth to nine children. After this the menses appeared only slightly at the regular periods until July, 1838, when they entirely ceased. Owing to this, she supposed that she was not liable to become pregnant; but on December 31st, 1839—therefore eighteen months after the entire cessation of the menses—she was delivered of her tenth child. Hence conception must have taken place at from eight to nine months after the final cessation of the discharge.

6. **The Oldest Recorded Age for Pregnancy.**—Dixon Mann (*loc. cit.*) quotes five cases, apparently well authenticated, of the following:—1. A woman of 55, menopause not mentioned; 2. A woman of 49, menopause at 47; 3. A woman of 50, menopause at 48; 4. A woman of 59, menopause at 51; 5. A woman of 72, menopause at 48, all giving birth to children. Duncan concludes, from his researches, that the great majority of the population is recruited from women under 30, but that the mass of women of from 30 to 40 years contribute to the general fertility a larger proportional share than the mass of women from 20 to 30. There is gradually increasing fecundity as age advances up to about 25, and then it diminishes (*Edin. Month. Jour.*, November, 1864, p. 450). The age at which

women cease to bear children is usually from 40 to 50 years; but as they may menstruate, so they may conceive, beyond the last of these periods. Besides, the facts above-mentioned show that the continuance of menstruation is not absolutely necessary for conception. Numerous instances are on record of females advanced in life bearing children. A case is reported in which a well-formed woman, who had been married nineteen years, did not bear a child until she had reached the age of *fifty* (Schmidt's "Jahrb. d. Med.," 1838, S. 65; Henke's *Zeitschr.*, 1844, S. 251). In this case it is stated that menstruation had ceased two years before conception. Rüttel observed in twelve women that they bore their last children at ages varying from forty-five to fifty years. Ottinger met with an instance of a woman bearing a child at fifty; Cederschjald with another, where the woman was *fifty-three*, and menstruation still continued. Haller records two cases in which women at *sixty-three* and *seventy* respectively bore children (Briand, "Man. de Méd. Lég.," p. 137). Nevermann has drawn up a table in reference to the late ages of life in which women have borne children. Out of 1,000 cases in 10,000 births, he found that 436 children were borne by females at the ages respectively:—

Of 41 years	101
„ 42 „	113
„ 43 „	70
„ 44 „	58
„ 45 „	48
„ 46 „	12
„ 47 „	13
Of 48 years	8
„ 49 „	6
„ 50 „	9
„ 52 „	1
„ 53 „	1
„ 54 „	1

A case was communicated (*Med. Gaz.*, vol. 39, p. 950) by Davies, in which a woman was *fifty-five* years of age when her last child was born: she menstruated up to that time.

In *Lord* v. *Colvin* (Vice-Chanc. Court, July, 1859), one of the questions raised was whether a woman, æt. 52, who had been married thirty years without having children, had then passed the age of child-bearing: her issue would take the benefit of certain property under a will. It was decided that the woman had not reached an age at which it could be said to be *impossible* that she might bear children.

In a return of the Registrar-General for Scotland (February, 1862), it is stated in the Table for Glasgow that two women became mothers as late in life as at 51, four at 52, and one woman was registered as having given birth to a child in the fifty-seventh year of her age. For a case in which pregnancy and abortion in a woman of fifty-six gave rise to serious trouble, *vide B. M. J.*, 2, 1903, p. 323, where also are other collected statistics.

We cannot pretend to fix the age beyond which pregnancy cannot occur. Questions of this kind have an important bearing on the subject of legitimacy; and unless the law looks to something more than ordinary professional experience in such matters, the decisions of courts must be inequitable.

The legitimacy of the claimant to the Douglas Peerage, about the middle of the last century, was contested, among other grounds, upon the presumed loss of procreative power in the woman said to be the mother, who was in the fiftieth year of her age at the time of the alleged birth, and who therefore must have conceived when in her *forty-ninth year*. Lords Camden and Mansfield justly decided that this was no objection to the legitimacy of the appellant. The fallacy of trusting to a ground of this kind as evidence of illegitimacy is proved by a reference to the numerous instances already quoted. The following cases show the more recent decisions on this subject:—In *In re Winslow's Trusts*, Malins, V.-C., made an order for payment out of court of two sums to two ladies respectively. One of the ladies was a widow, about fifty-five years of age; the other, a spinster, was fifty-three years and eight months old. In both cases the parties were entitled absolutely, subject to the contingency of their having children. In a more recent case (*Conduitt* v. *Soane*, May, 1871), Wickens, V.-C., declined to act upon the presumption where the lady was in her fifty-third year. This was a case arising out of the will of Sir John Soane. He had directed his trustees to convey his estates to his great-grandchildren, upon whom he had also settled a large amount of personalty, now represented by upwards of 180,000*l.* in court. The testator left two sons, who each left children; several of the grandchildren had died, without leaving children, the survivors being two daughters of the eldest son, who were both married but had no children; and two daughters and a son of the younger son. The married ladies were stated to be of the age of fifty-seven and fifty-two years, and the case now came before the court to obtain its sanction to a sale of a part of the real estate, on the assumption that they were beyond the age at which it could be expected that they would have children. The Vice-Chancellor declined to make any order as to the sale of the real estate, stating that he did not consider he had any jurisdiction to do so. In one instance which he had heard mentioned by the Master of the Rolls, a child had been born when the lady was six years beyond the age of the younger of these two ladies.

In *Forty* v. *Forty* (February, 1853), Kindersley, V.-C., decided that an unmarried lady, æt. 53, might be presumed to be beyond the age of child-bearing, although in this case security was required for the repayment of the money in the event of her marrying and having lawful issue. On this precedent, a woman who has passed the age of fifty-three is presumed in law to be past the age for child-bearing (*Med. Times and Gaz.*, 1871, 2, p. 114).

A case somewhat similar to the Douglas case was the subject of a trial in France in 1754. François Fajat claimed an estate as heir to his mother. His claim was resisted on the ground that, according to the baptismal registry, his mother could not have been the legitimate heiress of the party through whom the claim accrued; because her alleged mother would then have been in her *fifty-eighth* year; and this, it was alleged, was beyond the age of child-bearing. Ancient records were searched, and the claim of legitimacy was admitted, because menstruation and conception had been known to occur at periods of life even later than this (Capuron, "Méd. Lég. des Accouch.," p. 93). This author quotes a case in which a healthy woman menstruated until she had passed her *sixtieth year*, and her last child was born when she was *sixty years* of age (*op. cit.*, p. 98).

Other cases of births at the respective ages of sixty-three and sixty-five are referred to, but these appear to be of a less authenticated kind. The truth is, in giving a decision, the law is bound to look to the anomalies connected with the exercise of the generative function; and therefore the limited experience of a few medical witnesses, casually taken, can hardly be expected to supply satisfactory answers to questions of this kind. It establishes no presumptions respecting the presence or absence of child-bearing power at any period of life; but leaves each case to rest upon the whole of the circumstances which attend it. The record still seems to remain with Dixon Mann's case, æt. 72.

In the Court of Appeal in May, 1904, the following case was decided. The report has historical value for its legal references, and is therefore quoted in full:—

Before Lords Justices Vaughan Williams, Stirling, and Cozens-Hardy.

The singular task, but important one from a legal standpoint, was set their lordships of deciding at what age a woman should be presumed to be incapable of child-bearing.

The matter arose by way of an interlocutory appeal from a refusal of Mr. Justice Buckley to order to be paid out of court two sums amounting in the aggregate to 6,041*l.*, which stand to the credit of a Mrs. Hoyland and her children.

The money was left in trust for Mrs. Hoyland for life, and after her death to her children on their attaining the age of twenty-one. Mrs. Hoyland was born in January, 1852, and was, therefore, aged fifty-two years and four months. She was married on August 19th, 1875, and had five children, the four who survived having all attained the age of twenty-one, the two youngest—twins—being born on May 27th, 1882. Mr. Hoyland died on March 22nd, 1896. For some years prior to his death he was not living with his wife, but for six years after the birth of the twins they did live together.

Mr. H. Terrell, who represented Mrs. Hoyland, pointed out that the real issue was at what age a woman ought to be presumed to be incapable of child-bearing. The question had frequently been before the courts, but no settled rule had been laid down, except in the case of *Groves* v. *Groves*, when the age was fixed at fifty. In a peerage case, *Price* v. *Bowstead*, similar to this, an order was made in favour of the petitioner, who was fifty-three. Other cases similar to this, in which orders were made, were *In re Widdowson's Trusts*, the age being fifty-three years and nine months, and *In re Milner's Estate*, the widow being forty-nine and a half, and having been married twenty-six years, without children. In the case of *Brown* v. *Taylor* the widow was fifty-two, and had two children, and an order was made; in the case *In re Allanson's Trusts*, the widow had been married fifteen years, was fifty-one years and eleven months old, and there were no children. There again an order was made. In *Archer* v. *Dowsin* the widow was fifty-three, the only child was twenty-two, and the husband had been dead four years, and it was presumed there would be no more children. In *Paterson* v. *Kempton* an order was made in favour of a spinster aged fifty-four; in *Hodges* v. *Hodges* an order was made in favour of a lady who was fifty-five, had been married eight years, was living with her husband, and had no children; and in *Graham* v. *Parsons*, Vice-Chancellor Bacon made an order in favour of a widow aged fifty-one, without children.

Lord Justice Vaughan Williams thought there had been a general unwillingness to make a presumption before the age of fifty-three or fifty-four, unless there were special circumstances. His lordship cited a case in 1866, when a number of cases dealt with in two centuries were set out in order of date, the ages being, respectively, 69 years, 66 years, 65 years, 64 years, 59 years, 57 years, 56 years, 55 years, and 53 years. For some reason or other, he commented, there had been steady progress downwards in these two centuries, seeing that our great grandfathers put the age at 69 years.

Lord Justice Cozens-Hardy remarked that the courts never made the presumption now if the age was under fifty.

Mr. Terrell said Mr. Justice Buckley thought the age should be fifty-four and a half. In the first case there was little probability of the widow marrying again, and the chances of additional children were very remote. If the fund were not paid out she and the children might die without having the benefit of it.

There was no opposition on behalf of the trustees to the application.

Lord Justice Vaughan Williams thought the mere fact that the petitioner was fifty-two was not sufficient in itself to justify the presumption. The circumstances of each case must always be regarded. Seeing that the petitioner was fifty-two, that her last child was born in 1882, and that she had lived with her husband for six years after that, and considering also that they would not be interfering with the right of any living person, he thought they might safely make the presumption and the order for payment out of court.

The order for payment was accordingly made.

(B) Sterility from Surroundings.

(*a*) *In the Male.*—Apart from impotence, the law takes no cognisance of sterility in the male: as a medical question it could only be decided by finding that all the spermatozoa in the testicular secretion were motionless and dead. Personal abuse is alleged to cause it, but this the editor would think is extremely doubtful. No further comments are necessary from a medico-legal point of view.

(*b*) *In the Female.*—We have only to appeal to known facts amongst domestic animals and amongst wild animals kept in a state of confinement to be at once certain that surroundings have some influence upon conception; many of such have been examined after death and found to be perfectly healthy and capable of bearing progeny so far as anatomy or structure is concerned. Again, in human beings there are many instances of women who have been sterile to one husband and fertile to another without any suspicion of the fault lying with the husband, or rather, without any proof that such was the case. The explanation of these facts is obscure. On the one hand, disease may be of such a subtle or physiological character that the ova of the female may be incapable of fertilisation; on the other hand, there may be mechanical impediments to the proper meeting of sperm and germ, impediments of such slight character as to be overlooked on autopsy. For a few further remarks, *vide* "Sterility from Disease."

(C) Local Causes for Sterility.

Congenital Conditions.

In the male
- Absence of testicles.
- Absence of penis (?).
- Ill-development of testicles.
- Disease of testicles *in utero* (?).
- Misplacement of testicles (?).
- Malformations of penis, epi- and hypospadias.

In the female
- Absence of ovaries.
- Absence of uterus.
- Ill-development of ovaries.
- Ill-development of uterus.
- Absent vagina.

Acquired Conditions.

In the male
- Complete amputation of penis (?).
- Excision of testicles.
- Disease of testicles.
- Accident to testicles.
- Atrophy of testicles from mumps, etc.
- Masturbation and spermatorrhœa.

In the female
- Excision of ovaries.
- Disease of ovaries.
- Excision of uterus.
- Disease of uterus.
- Occlusion of vagina from disease.
- Disease of vagina.

CONGENITAL CONDITIONS IN THE MALE.

It will only be necessary to say a few words on some of these conditions.

Complete absence of testicles and of penis are theoretically possible conditions, but no record seems to exist of a case in which the fact has been of any medico-legal interest whatever; and, except in monstrosities, such a condition must be of most extreme rarity. Of ill-development of the testicles, due to intra-uterine disease, the same remarks may be made; a case is quoted under "Impotence," *supra*.

Sterility in Relation to Monorchism and Cryptorchism.— In some males the testicles do not descend into the scrotum at the usual period, but one or both may remain in the abdomen, or in the inguinal canals, and only descend some time after birth or not at all; or one may be found in the scrotum, and the other remain during life in the abdomen. Persons with no apparent testicles are called *Cryptorchids*, while those who have only one testicle apparent are called *Monorchids*. In some cases of partial descent the organs have been mistaken for and treated as ruptures by the application of a truss. In one instance the attempt to reduce the tumour, mistaken for hernia, and the application of a truss, caused the death of the person (*Med. Times and Gaz.*, 1861, 1, p. 240). When one testicle only has descended, there is no ground, *cæteris paribus*, to impute impotency: the descended organ has been found healthy and to contain spermatozoa, while the retained testicle and its ducts have in some cases been found not to contain spermatozoa. Curling collected six of these cases, of which four fell under his own observation ("On Sterility in Man," 1846, p. 6; *Med. Times and Gaz.*, 1861, 1, p. 213). When neither testicle has descended, the scrotum will be found empty, without any scar indicative of a removal by operation, but the other marks of virility may still be present.

It has been stated that in all cases of non-descent, the testicles are congenitally defective, and further, that the persons, although capable of sexual intercourse, are incurably sterile. Hunter thought so. Some cases support this view. In 1860, Partridge met with the case of a man of twenty-five, in whom both testicles were found in the abdomen. Several specimens of the secretion were examined, and no spermatozoa were detected. Another case was examined with a like result (*Lancet*, 1860, p. 66), and a third by Curling (*Med. Times and Gaz.*, 1861, 1, p. 213). The cases of monorchids reported by Curling (*op. cit.*, p. 8) to some extent support this theory, since spermatozoa were found only in the fluid of that testicle which occupied its usual position in the scrotum. He also collected from various sources seven cases of cryptorchids, in which both testicles were either in the abdomen or in the inguinal canals; the fluid contained in them was destitute of spermatozoa, and, although impotency did not exist, these persons either were or were presumed to be unprolific. Godard has noticed that horses whose testicles are retained in the abdomen, although capable of intercourse, are sterile, and veterinary surgeons consider this the rule.

On the other side of the question there are, however, facts which are wholly inconsistent with this theory. Two cases of cryptorchism occurred in the practice of Cock. The testicles in these men had not descended, but their virile functions were undisputed. One of them, before he had reached the age of thirty years, had been twice married, and had had children by each wife, besides illegitimate children which were affiliated on him during the time he lived in service. In a report of cases of hernia by Poland (Guy's Hosp. Rep., 1843, p. 163), there is the case of a man, æt. 29, a cryptorchid, whose testicles had never descended. Poland states that there was not the slightest trace of scrotum, but the penis was well developed, and there were all the other signs of virility. This man married when he was twenty: he had had two children by his first wife, and at the time of his admission into the hospital had been married two years to a second wife. In 1862 there was in Guy's Hospital a patient whose testicles had not descended—they were lodged in the inguinal canals. The man was thirty-two years of age, well developed, with every appearance of virility about him, and with the same masculine development which is seen in other men of the same age. This man was married, and had had two children by his wife. Since puberty he had always been competent, and he ridiculed the idea that his testicles were inefficient. Another case is referred to by Curling (*op. cit.*, p. 9), which occurred to Debrou. The testicles were in the inguinal canals; there was no scrotum. The man had been married, and had had one son by his wife.

The following case is reported by Dr. R. Milner Smyth, Assistant Medical Officer, Government Hospital, Durban, under date July 26th, 1899: "W. H., a seaman, æt. 34, admitted for strangulated hernia. At the operation the right testicle was found behind the loop of strangulated gut in the inguinal canal, the left was easily felt at the margin of the external ring in the canal; recovery was rapid, but he had an attack of orchitis. The earlier history is as follows: Since childhood has always enjoyed excellent health. The testicles were never at any time in the scrotum, and of this he never seems to have taken any particular notice. He is now thirty-four, a strong, fully-developed muscular man. Since puberty has had full sexual power, and was married sixteen years ago at the age of eighteen; five children born to him, one being now alive. The testicle which was seen and examined in the canal was smaller than normal, soft and elastic on pressure. The left appears of about the same size and character. The penis was well developed. I may say that the man has been seen by several practitioners, and there is no doubt whatever of the paternity of the children, his wife being devoted to him and her children, and the home life is a particularly happy one."

By these facts, therefore, it is established that cryptorchids are not necessarily sterile, and that no absolute rule can be laid down respecting the existence or non-existence of prolific power under such circumstances. It has been objected that, in the above instances of prolific power, spermatozoa have not been proved to exist in the spermatic secretions of the individuals, and that the evidence is therefore incomplete. But these bodies have not been proved to be absent, and most persons will agree that there is no better evidence of prolific power than the procreation of children, whether spermatozoa are or are not detected—a matter which will sometimes depend on the accuracy of observation or experience of the examiners or, it may be, on a morbid state of secretion. In one case Casper found spermatozoa in the fluid emitted by a cryptorchid ("Gerichtl. Med.," vol. 2, p. 187). One affirmative instance is sufficient for all the purposes of law, to overthrow ninety-nine negative instances; and, as a physiological fact, it is obvious that the organs which have not descended are not always defective in structure or function. The facts above mentioned prove that there is no reasonable ground for pronouncing them to be absolutely sterile or unprolific, merely because their testicles are not in the scrotum. If, with a non-descent of these organs, there should be a non-development of the other external organs, and this is accompanied by a total want of the characters of virility, then the person may be impotent or sterile, or both. The testicles may, in such a case, be either congenitally absent or physically imperfect—a fact only ascertainable by an examination of the body after death. On the other hand, in cases in which there are no external marks of effeminacy, or other grounds for suspecting a want of procreative power, and the person is capable of sexual intercourse, this imperfection does not offer any bar to marriage, nor is it a sufficient ground for divorce. It would not justify a medical man in denying the paternity of a child on a question of affiliation, bastardy, or inheritance; and so long as the power of sexual intercourse existed, it would not justify him in pronouncing the person to be incurably sterile. The capacity for sexual intercourse is the fact to which the English law commonly looks on these occasions. If this exists, then it will hardly entertain the question—surrounded as it may be with conflicting medical opinions—whether from the mere retention of the organs in the abdomen, the fluid secreted is, or is not, of a prolific nature?

Epi- and Hypospadias.—These terms merely refer to malformations of the penis of such a nature that the opening of the urethra—through which the seminal fluid has to pass—is not situated at the end of the glans penis, but at a varying distance from the end, either on the dorsum (epi) or on the under surface (hypo) of the penis. Cases of either condition are by no means infrequent, scattered through all medical journals. Unless the condition is associated with some other developmental anomaly—absence or ill-development of the testicles—there can arise no question of *absolute* sterility, for the seminal fluid is in itself as fertile as possible; but the question is simply one of whether, in the natural act of copulation, the semen will be placed within the vaginal orifice, and so have an opportunity of reaching the ovum (*vide* "Artificial Impregnation"). It is reported that some aboriginal tribes in uncivilised countries have recourse to artificial hypospadism as a means of allowing unfruitful connection.

The power to have fruitful intercourse will in either case depend on the situation of the urethral aperture.

In 1850, a lad, aged seventeen, was summoned on a charge of affiliation, in reference to the pregnancy of a girl aged eighteen. The defence was that he could not be the father of a child, because there was such a malformation of the penis as to prevent prolific intercourse. On examination, the urethra was found to terminate on the under-surface of the penis, about an inch and a half from the glans, by a small elliptical orifice, which allowed the urine to pass, but with some difficulty. One medical witness gave it as his opinion that it was not impossible, but highly improbable, that the defendant should possess procreative power; another freely admitted the boy's capacity, and the case was decided against the defendant. He was pronounced to be the father (*Med. Times*, 1850, 2, p. 321).

This decision was physiologically correct. When the urine can pass, the seminal fluid can pass; and the only question is, whether the intromission can be such as that the misplaced orifice should come in contact with any part of the vagina. This must depend on the situation of the orifice. Similar remarks apply to epispadians. These malformations are sometimes remediable by operation; but whether remediable or not, they are not, under any circumstances, to be regarded as absolute causes of sterility.

A case, apparently involving a question of this kind, was tried at the Manchester Lent Assizes, 1867 (*R.* v. *Milner*).

A woman was indicted for perjury. She had sworn, in an affiliation case, that one Shepherd was the father of her child. A few months before the child was born, Shepherd had married another woman. Shepherd swore that he never had had connection with the woman, alleging that he was impotent and incapable. Three surgeons swore, from an examination of Shepherd, that it was impossible that he could be the father of the prisoner's child. Shepherd's wife also swore that her marriage had never been consummated. Prior to her marriage she had had a child. Two medical men were then called for the defence, and they said, although Shepherd was somewhat different from other men, it was more than probable that he might have a family. Shee, J., stopped the case, and said that, as the medical evidence was very conflicting, it was impossible to convict the woman.

CONGENITAL CONDITIONS IN THE FEMALE.

On the congenital conditions enumerated above, not much needs to be said. Sterility rarely becomes a medical question in contested cases of legitimacy; for the claim on the part of a person to be the offspring of a particular woman, unless she were in collusion with the claimant, could only be made after her death; and if not disproved by medical evidence, showing that the woman could not have borne children, it would in general be easily set aside by circumstances. If the uterus, ovaries, or other parts were congenitally defective or absent, or if there were external sexual malformation, accompanied by occlusion or obliteration of the vagina, a medical witness would have no difficulty in saying that the woman must have been sterile. A mere occlusion of the vagina, removable by operation, does not necessarily indicate sterility, for the internal organs, including the womb, may be healthy and sound. In some instances the ovaries or the uterus *are* entirely absent, or the Fallopian tubes *are* obliterated—conditions which cannot in all cases be determined during life; whilst in other instances these organs exist, but are defectively developed. The absence of a womb, and the absence of the function of menstruation, do not necessarily prevent the development of strong sexual propensities, although there is of course incurable sterility (see case in *Assoc. Med. Jour.*, July 29th, 1853, p. 672.) A congenital absence of the uterus and ovaries is not inconsistent with a full development of other parts. Hertz met with a case of this kind.

A woman, æt. 40, had enjoyed good health up to the last year of her life. On inspection there was a complete absence of the uterus and ovaries. The vagina was normal, terminating in a cul-de-sac. The clitoris was well developed, together with the labia and mons veneris. The breasts were large and plump. The whole aspect attested the attributes of a well-formed woman (*Amer. Jour.*, July, 1870, p. 280).

Some of these deficiencies can with certainty only be detected after death.

Some of the physical causes of sterility in a woman are removable by art. Thus, when the vagina is unnaturally closed, this condition may be often remedied by operation. An instance of this kind is related by Dumville (*Med. Gaz.*, vol. 40, p. 1116), in which a woman subsequently married and bore a child. It is a fact worthy of notice, that if the internal organs are in their normal condition, the slightest aperture will suffice for impregnation. Penetration is not necessary (*vide* "Signs of Virginity"). Women have thus been known to conceive under circumstances which appear quite adverse to the possibility of conception: and when they have arrived at the full time it has been found necessary to make a free incision into the parts which resisted the passage of the child's head. A remarkable case of this kind is quoted in the *B. M. J.*, 1, 1910, and there are many others of a similar nature on record. Sometimes the external passage is free, but the congenital occlusion may be at the mouth of the uterus. This is a cause of sterility, which, however, admits of remedy by operation. Cases of this kind are successfully treated.

ACQUIRED CONDITIONS.

In the Male.—With regard to penile conditions the question is really rather one of impotency than of sterility (*vide ante*), but it is of course obvious that complete amputation must render both conditions certain.

With regard to testicular disease, accident, or removal, the question is more complicated, for it involves two separate considerations, or perhaps three. First, the actual formation of spermatozoa; secondly, and equally important, are those formed, alive (fertile)? and thirdly, can they escape from the male organ? There can be no doubt about the extreme case of amputation of the testicles causing *ultimate* sterility, though even here animals have been known to be prolific for a certain time after castration; and one case is on record in which a man, both of whose testicles had been carried off by a gunshot, is said to have retained the power of impregnating his wife, after the healing of the wound (Henke's *Zeitschr.*, 1842, 1, 348, and 352). It must be assumed that the vesiculæ seminales contained sufficient semen for the purpose.

With regard to disease, it is by no means easy to determine what degree of it will render a man sterile; if with extreme wasting of the testicles or very extensive disease, sexual desire entirely disappears, there can be no doubt of sterility, but the fact itself of absence of desire under such circumstances cannot be proved by medical evidence, it must depend upon the statement of an interested party. It is stated to have been proved by microscopical examination that spermatic secretion of fertile (or at least living) spermatozoa still continues even when only a small part of the gland has remained healthy.

Stricture of the urethra need not be considered, for where urine can pass semen can do so, but it is otherwise when the spermatic cord is from art or disease blocked, ligatured, or cut in any part of its course; such a condition if provable would render sterility certain.

It is alleged that excessive personal abuse will render a man sterile; it is to the last degree difficult to obtain any evidence on this point, but the editor believes the statement to be absolutely incorrect, though he thinks that a condition of emotional impotency might temporarily arise from this cause.

In the Female.—This subject belongs so much more to clinical gynæcology than to forensic medicine, that little needs to be said upon it. Cases are recorded from time to time in which women have borne children even after double ovariotomy. In the *B. M. J.* for March 26th, 1904, are reported two or three cases of impregnation under conditions which would at first sight render it impossible. A discussion will also be found in the same place on how the ripe ovum reaches the uterus. Clinically there can be no doubt about all the diseases enumerated above causing an incapability on the part of a woman of having *living* children, but as this is not considered sufficient ground for divorce, it never comes before a court of law as a subject upon which medical evidence is required *re* Sterility, though the *cause* of the disease may do so (*vide* "Divorce").

Condamine, of Lyons, in the "Ann. de Gynec. et d'obst." for March, 1904, gives instances of pregnancy in women the subjects of bilateral ovarian dermoid tumours.

An absence of the menstrual function (amenorrhœa) has been described as a cause of sterility; but several cases have been already mentioned, which show that women who have never menstruated, or in whom the discharge has appeared and has ceased for many years, and who are otherwise healthy and well formed, may become impregnated. When, however, the absence of menstruation depends on a closure of the mouth of the uterus, or other physical causes of the like nature, there will of course be sterility. If in other respects a woman is well formed, she cannot be regarded as in a necessarily incurable condition. Oldham has published two cases in which the women had each attained the age of 48 years without having menstruated (*Med. Times and Gaz.*, 1852, 1, p. 311). There was general good health, with a proper development of the sexual organs, in both.

Women who have not menstruated before marriage have conceived immediately after their marriage. Instances are well known to occur in which a woman has not menstruated for some months previous to conception, and thus gestation has appeared to be considerably protracted. Hence a woman may conceive, although menstruation has not commenced, and although it may have commenced and afterwards ceased (*vide ante*, under "Age and Sterility").

There is a popular notion that women during menstruation and lactation are sterile; but this is incorrect, as all gynæcologists can testify. Well-organised and healthy women remain sometimes married for years without having children; when, without any apparent change of habit, they become impregnated even after a barrenness of fifteen or twenty years. Any diseased condition of the system is unfavourable to impregnation, and *à fortiori* diseases affecting the uterus or ovaries.

For the effect of chronic uterine disease on fertility, manuals of gynæcology must be consulted.

On the whole, the physical and irremediable causes of sterility in the female are not so apparent as in the male, because in the former the generative apparatus is placed internally, and slight changes in its various parts, sufficient to produce permanent sterility, cannot be determined by an examination during life.

The whole subject is one in which it is extremely important to note the difference between fact and presumption. Sterility and pregnancy are facts while they last, but to state that sterility must be permanent is an assumption which must be supported by strong evidence before it can be accepted as a fact.

SUB-SECTION B.—SIGNS OF VIRGINITY AND DEFLORATION.

A *virgo intacta* was once defined at a critical moment by a judge as a *rara avis*, and, so far as medical evidence is concerned, the definition might almost stand, for though we have many conditions found in *virgines intactæ*, there is no one of them that may not be found in a woman who has had isolated acts of connection, or even habitual connection, provided that she has not borne a child. As, however, the question may assume some importance in (*a*) divorce; (*b*) the reputation of a single woman; (*c*) the credibility and character of a person who makes a charge of want of chastity against a woman, it becomes necessary to consider the evidence in some slight detail. The following are the points usually relied upon to establish the condition of *virgo intacta*.

1. **The Breasts.**—These in young adults are commonly firm and hemispherical, the nipples small and surrounded by areolæ from light pink through slightly darker shades of colour, according as the possessor is blonde or brunette. It cannot be supposed that a single act of coitus will alter this, and the editor has seen and noticed in the wards women with five or six children to whose breasts the above description would apply; he has, too, seen and treated in 1903 a girl in whom there was no reason whatever to suspect unchastity, but whose breasts were freely secreting milk and continued to do so over a period of two years or more. It is, therefore, abundantly evident that the breasts fail us absolutely as a sign of virginity.

2. **The Hymen.**—This is practically always present in a *virgo intacta* in some form or other, but even here it has to be admitted that in certain cases, rare though they may be, it is congenitally absent. The hymen may be intact, but this does not prove non-intercourse, because females have been known to conceive with the hymen uninjured; and an operation for a division of this membrane has been frequently rendered necessary before delivery could take place. Two cases of impregnation without rupture of the hymen are reported (*New Orleans Med. Gaz.*, June, 1858, pp. 217, 220). The hymen in each case required to be divided to allow of the delivery of the child. Another case is reported (*Amer. Jour. Med. Sc.*, April, 1860, p. 576), another in the *Lancet*, 2, 1898, p. 1261, and many more are to be found in medical journals. These facts may be explained by the membrane being hard and resisting, and at the same time small in extent, *i.e.*, only partially closing the vagina. (It must be remembered that the hymen is extremely variable in shape and size, and in the opening or openings through it.) The hymen may be destroyed by ulceration, as a result of inflammation of the genital organs. When

the membrane has been thus destroyed by disease or other causes, or when it is congenitally absent, a medical opinion must be more or less conjectural; for one intercourse could hardly so affect the capacity of the vagina as to render the fact evident through life, and there is no other datum upon which an opinion could be based. If a fairly resistant hymen with small opening be found quite intact, there is a fair presumption of chastity; if, on the other hand, there be a very soft and resilient hymen with a large opening, no opinion can be offered. The presence of the hymen is of course incompatible with the assumption that the female has borne a child. A question of this kind incidentally arose in *Frazer* v. *Bagley* (Common Pleas, February, 1844).

It was alleged by defendant that the plaintiff, a married man, had had adulterous intercourse with a young woman, and that at an antecedent period she had left her home for the purpose of giving birth to a child privately. Ashwell deposed that, in his opinion, the woman was a virgin, and had never had a child. In spite of this evidence, the jury returned a verdict for the defendant.

It is possible, however, that abortion may take place at the early periods of pregnancy without the necessary destruction of the hymen.

In 1845, a gentleman was brought to a court-martial on a charge of having deliberately and falsely asserted that on several occasions he had had connection with a native woman. This was denied by the woman, and evidence was adduced to show that she had still what is commonly regarded as the main sign of virginity, namely, an unruptured hymen. In consequence of this, the gentleman was found guilty and cashiered. The woman was at the time about to be married, and this rendered the investigation all the more important to her. A surgeon, who examined the girl, deposed that he found the membrane of a semi-lunar form, and tensely drawn across the vagina; and his evidence was corroborated by that of a midwife. The inculpated person took up a double line of defence—1st, that the examination of the woman was incomplete; and 2nd, that the hymen, if present, would not justify the witness in saying that intercourse could not possibly have taken place.

Fruitful intercourse, it is well known, may take place without rupture of the hymen. Some instances of this kind were referred to at the court-martial; but such cases are usually regarded as of an exceptional nature. The real question is, whether, unless the hymen be in an abnormal state, intercourse can possibly occur between young and active persons without a rupture of this membrane. Intercourse is not likely to be confined, under these circumstances, to a mere penetration of the vulva. The membrane in this woman is stated to have been tensely drawn across the canal, and it was not tough; it was therefore in a condition to render it most easy for rupture. In the case of an old man, or of one of weak virile power, vulval intercourse might be had without destroying the membrane; but such a case could only be decided by the special circumstances which accompanied it. The presence of the unruptured hymen affords a presumptive but not an absolute proof that the woman is a virgin.

Admitting the statements of the examiners to be correct, it is improbable that this woman had had sexual intercourse several times, or even on one occasion.

In the case of *Delafosse* v. *Fortescue* (Exeter Lent. Ass., 1853), which involved an action for defamation of character, the plaintiff, a married man, æt. 64, had been charged with committing adultery with a certain woman. Several witnesses for the defendant positively swore that they had seen these persons in carnal

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intercourse. This was denied by the plaintiff; and, as an answer to the case, medical evidence was tendered to the effect that the woman with whom the adulterous intercourse was alleged to have taken place had been examined, and the hymen was found intact. In cross-examination, however, this was admitted not to be a conclusive criterion of virginity, and a verdict was returned for the defendant.

The form and situation of the hymen in this case were not described; but it is to be presumed that these were not such as to constitute a physical bar to intercouse, or this would have been stated by the medical witness. Hence the existence of the membrane was not considered to disprove the allegations of eye-witnesses. In Scotland this kind of medical evidence is not admissible. A wife sued her husband for divorce, on the ground, *inter alia*, that he had committed adultery with C. In defence the defendant denied the adultery, and adduced C. as a witness, who swore that such connection had never taken place. She also swore that she had submitted to an *inspectio corporis* by Simpson. The defendant then proposed to examine Simpson, that he might speak to the result of his examination. He argued that this was the best evidence that he could adduce in support of his innocence, as if the girl was still a virgin the adultery alleged could not have been committed. The court refused to admit the evidence, on the ground that the evidence proposed was merely that of an opinion from the professor; that other medical men might differ from him in opinion, even from the same observations; and that, as the court could not compel C. to submit to another examination, the proposed evidence must be considered *ex parte* and inadmissible (Sessions Cases, Edin., February 11th, 1860). In *Hunt* v. *Hunt* a verdict was obtained at common law against the alleged paramour in a case of adultery. It was subsequently proved that the lady was *virgo intacta*. So long as there are facts which show that women have actually conceived with the hymen still in its normal state, it is inconsistent to apply the term *virgo intacta* to women merely because this membrane is found entire. A woman may assuredly have an unruptured hymen, and yet not be a *virgo intacta*. This can only be decided by the special circumstances proved in each case. A similar question arose in *R.* v. *Harmer* (C. C. C., June, 1872). The prisoner was indicted for perjury. He was a waiter at a tavern, and being called as a witness in a divorce suit, swore that he had seen one of the parties in an adulterous intercourse on more than one occasion. The lady with whom the adultery was alleged to have been committed denied this on oath, and Lee and another medical expert gave evidence that they had examined this lady, and found her to be a *virgo intacta*. He was found guilty.

So far as rape is concerned, *vide* "Rape," the hymen is of still less use than in the above cases, where complete intromission of the penis is tacitly assumed.

Dixon Mann, "For. Med.," p. 100, makes the following observations on a ruptured hymen:—

The hymen may be ruptured by an adequate force of any kind, apart from sexual intercourse. It is reported to have given way from the presence of blood-clots during menstruation, from ulceration following diphtheria or other diseases, from jumping, riding on horse-back, or falls on a hard projection. Masturbation has been stated, but probably without sufficient grounds, to be a cause of rupture of the hymen; in the majority of cases of habitual masturbation the hymen will be found intact, the manipulations being limited to the parts anterior to it. Medical examination or applications may cause injury to the hymen. Some of these reasons for the absence of, or injury to, the hymen are quite feasible, others are far-fetched; each case has to be judged on its own merits.

Accidental Laceration of the Perineum in a Child seven years old.—She was standing on an iron fence and fell, striking the perineum against a knob on the top of a post. Dr. J. Nord Thompson saw her two hours after the accident, and everything about the perineum seemed to be lacerated. Upon closer examination he found the vaginal wall torn as far as the cervix; the sphincter ani and the rectum were also torn. There was only a slight hæmorrhage (*Amer. Jour. of Obstetrics,* 1888, vol. 21, p. 974).

Several cases have come to my (Dr. Howard A. Kelly) notice in which little girls have had their perineum torn from vagina to anus, opening the whole recto-vaginal septum, by sliding down a baluster and striking the flat boss on the top of the newel-post.

In any gynæcological text-book will be found an anatomical account of the hymen and its different appearances (*vide* also Horn's *Viertel-jahrsschr.*, 1866, 2, p. 47; also a paper by Hoffman in the same journal, 1870, 1, p. 329). Tardieu has also published a work with illustrations showing the various appearances which the hymen may present in virgins and others ("Etudes Médico-Lég. sur les Attent Aux Mœurs," 1873).

3. **The Vagina.**—In girls who have not had intercourse the vaginal walls are rugose and firm. This is true, but again it can hardly be supposed that one act will so stretch them as to deprive them of tone and rugæ, but if the act be habitual and, *à fortiori,* if parturition has taken place, these rugæ are likely to have disappeared. For all that the sign is likely to fail when most wanted, for in habitual connection there is likely to be other evidence.

4. **Fourchette and Perineum.**—The former is the thin posterior edge of the margin of the mucous membrane, the latter the edge of the skin, limiting the vaginal orifice. In a *virgo intacta,* both of them are discernible and untouched. The fourchette is frequently ruptured by the first connection, and Dr. Bulloch reports to the editor that in the De Lisle case in 1904 the perineum was actually ruptured by coition. The relative sizes of the aperture and the organ introduced through it together with the degree of violence of introduction would account for etther membrane being torn or remaining intact.

SIGNS OF LOSS OF VIRGINITY.

But little can be added to what has been said above on the presence of virginity. In cases of alleged rape (*vide* "Rape"), the presence of signs of violence, tears, signs of inflammation, discharges are all of material assistance, but these are quite apart from the abstract question of whether or no the person in question is a *virgo intacta* or not. We can only say that the absence of the signs mentioned above constitutes the only possible chance of answering the question, if the woman be examined at a time when signs of recent defloration have had time to disappear. In other words the signs of loss of virginity are:

1. Torn hymen.
2. Signs of injury.
3. Signs of implanted venereal disease;

and we know that all these may be otherwise accounted for.

The question is almost always one of general rather than purely medical evidence.

SUB-SECTION C.—PREGNANCY.

THE LEGAL POSITION OF PREGNANCY.
THE SIGNS OF PREGNANCY.
SUPERFŒTATION AND SUPERFECUNDATION.
THE DURATION OF PREGNANCY.

A MEDICAL man may be requested (he cannot be ordered ; at least the order has no validity, *vide* Vol. I., pp. 65 *et seq.*) by the law to examine a woman to determine whether she be pregnant or not for several reasons, viz. :—

(1) To respite a woman condemned to be hanged, or to undergo other severe punishment (hard labour).

(2) In connection with the possibility of a posthumous heir being born.

(3) To increase damages in a seduction case.

He may also find it necessary in private to do so—

(4) To disprove a libel.

(5) To suggest the advisability of a marriage.

(6) For many other purposes in his practice.

We may explain some of the legal purposes before entering upon the details of the evidence.

LEGAL CASES IN WHICH THE ESTABLISHMENT OF PREGNANCY IS REQUIRED.

(1) PLEA OF PREGNANCY IN BAR OF EXECUTION.

When a woman is capitally convicted, she may plead pregnancy in bar of execution. The judge will then direct a jury of twelve married women "*de circumstantibus*," to be empannelled, and sworn to try, in the words of the law, "whether the prisoner be with child, of a quick child or not." If they find her quick with child, she is respited : otherwise the sentence will take effect. In admitting the humanity of the principle by which a pregnant woman is respited until after her delivery, there are two serious objections to the former practice of the common law, whereby it is made to fall short of what, in a civilised country, society has a right to expect from it ; these are—1st, that the law allowed the question of pregnancy to be determined by a jury of ignorant women accidentally present in court ; and 2nd, that the respite was made to depend, not upon proof of pregnancy, but upon the fact of a woman having quickened, a sign of pregnancy which is extremely variable in the time of its occurrence.

It must be obvious, on the least reflection, that the means resorted to by the English law to determine such a question were bad, and quite unfitted for the present state of society. Several cases show that a jury of matrons may be easily deceived with respect to this sign of pregnancy. In *R.* v. *Wright* (Norwich Lent Ass., 1832) such a mistake was made.

The practice was revived at the Central Criminal Court in 1847 (*R.* v. *Hunt*, September, 1847).

This woman was convicted of murder; she pleaded pregnancy, and the matrons were empannelled and directed to use "their best skill" to determine whether the prisoner "was big with a quick child or not." It was left to their option to have the assistance of a surgeon. In half an hour they returned a verdict "that she had not a living child within her." The law was directed to take its course; and the woman would have been executed but for the interference of the Secretary of State. He directed that the prisoner should be examined by competent medical men, who ascertained that she was really pregnant, and had actually passed that stage at which quickening is most commonly perceived. She was therefore respited, and the error in the verdict of the matrons was proved by the birth of a child.

The actual words of the statute have never been repealed, but the custom is now obsolete, and judges always call in the aid of a medical practitioner to decide the mere fact of pregnancy quite irrespective of the period of conception at which the woman has arrived. The last case in which a jury of matrons with a forewoman was appointed was *R.* v. *Mary Boyle* (Lanc. Spr. Ass., 1904); this jury had the assistance of a prison surgeon.

(2) De Ventre Inspiciendo.

A woman may assert that she is pregnant at the time of her husband's death, and the heir-at-law may obtain a writ to require some proof of her alleged pregnancy, as his right to the estate of which the husband died possessed may be materially affected by the result. Until within a comparatively recent period the decision of the question of pregnancy was left to twelve matrons and twelve respectable men, according to the strict terms of the ancient writ; but in late cases it has been considered advisable to depart from this absurd custom, and to place the decision in the hands of skilled medical practitioners or obstetric experts.

[In 1835 in a probate case a writ of this nature was issued; full details will be found in old editions of this work.—Ed.]

The last writ *de ventre inspiciendo* on the petition of a would-be ejector was issued in May, 1847, by Vice-Chancellor Bruce (*Re Blakemore*, 14 L. V. ch. 336); the terms are "si impregnata sit necne et quando paritura." The widow, a barmaid, having been served with the petition, did not appear.

Such a writ is now obsolete.

These are the only two cases in which pregnancy has any direct relation to medical jurisprudence; and it is remarkable that, with respect to them, the law of England expressly provided that they should be left to the decision of non-medical persons. The following conclusions may therefore be drawn:—1. That the cases in which the signs of pregnancy become a subject of *legal* inquiry in England are rare. 2. That there is no case, in English law, in which a medical man will not have an opportunity of performing an examination *per vaginam*. 3. That a medical opinion is never required by English law authorities until the pregnancy is so far advanced as to render its detection *certain*. Hence discussions concerning areolæ, the condition of the breasts, etc., are, in a practical point of view, unnecessary to a medical jurist. By these remarks it is not intended to undervalue the importance of an accurate knowledge of the signs of pregnancy to a medical practitioner. Cases which may never come before a court of law will be referred to him, and the serious moral injury which he may inflict on an innocent woman by inaccuracy should make him scrupulously cautious in expressing an opinion. The case of Lady Flora Hastings furnishes a sad illustration of the effects of such a medical error (see *Lancet*, 1851, 2, p. 485). On other occasions the practitioner's own reputation may suffer by a mistake of this kind.

A married lady in Scotland, who had not had a child for a long period, thought that she had become pregnant, and consulted the chief physician in the place, a man of skill and experience. He saw her several times, and had every opportunity of examining her condition. He gave a decided opinion that she was *not* pregnant, The lady, however, made her preparations, and one night, not long after the medical opinion had been formally given, the physician was sent for to aid in the delivery.

Pregnancy may be feigned or alleged, and it is a medical man's business to be able to detect such imposture. A woman who is an impostor usually feigns an advanced stage of pregnancy. Although she may state that she has some of the symptoms depending upon pregnancy (and, unless she has already borne children, she will not even be able to sustain a cross-examination respecting these), yet it is not possible for her to simulate without detection a distension of the abdomen or the state of the breasts. If she submits to an examination, the imposition must be detected ; if she refuses, the inference will be that she is an impostor. Women have been known to possess the power of giving apparent prominence to the abdomen, and even of simulating the movements of a child by the aid of the abdominal muscles. By placing them under the influence of chloroform, the abdomen at once collapses, and the imposture is detected. These cases of spurious pregnancy are sometimes met with in hysterical females. [Phantom tumours of the abdomen are now well known in practice.—Ed.]

A medical man having given an opinion that a female patient was pregnant, subsequently brought an action against her for medical attendance. It turned out, however, that she was not pregnant, and that there were no satisfactory medical grounds upon which his opinion was based.

The plaintiff complained of having been deceived by the defendant as to her condition ; but it is obviously in the power of every medical man to prevent such a deception being practised on him.

That pregnancy may take place from intercourse during unconsciousness on the woman's part, or after rape, *i.e.*, involuntary connection, is, of course, possible. There can be no question about such matters ; the union of sperm and germ is as far out of the reach of the action of the mind as anything can be.

On the other hand, it is quite possible for women to be pregnant and not know it. It is hardly necessary for examples to be given, for such cases are the every-day experience of most medical men. The following is, however, worth quoting as an extreme case.

A married lady, who had not had a child for a period of nineteen years, found herself, as she thought, getting unusually stout. She was moving about with her family to different places. At last her size alarmed her, and she thought she was suffering from dropsy; she consulted a physician, who informed her that she was in an advanced state of pregnancy. She treated this opinion with great contempt. In travelling with her daughter, they arrived at a miserable inn; on the night of their arrival, this lady was seized with the pains of labour, and was delivered of a child. She had made no preparation for the birth, and up to the moment when she was seized with labour pains, she had not, with all her former experience, the slightest belief that she was pregnant. (For other cases, see *Lancet*, 1860, 1, pp. 609, 643.)

Instances of this kind are important in reference to alleged unconscious delivery in the cases of women charged with infanticide. At the same time, many of the cases in which there are motives for pleading unconscious intercourse or pregnancy require close examination: they will frequently be found to be quite unworthy of belief.

Concealment of Pregnancy.—By the law of Scotland, if a woman conceals her pregnancy during the whole period thereof, and if the child of which she was pregnant be found dead, or is amissing, she is guilty of an offence, and is liable to prosecution. The evidence which is relied on for conviction is clear and distinct evidence of the actual delivery of a child. This is generally furnished by medical witnesses. The Scotch law, by making the concealment of pregnancy, under the circumstances above mentioned, an offence, proceeds on the principle that every pregnant woman is bound to make preparations for the safe delivery of a child; and it is therefore assumed that if a child is born clandestinely, without preparation, and is found dead or is amissing, its death is owing to the want of such preparation.

Pregnancy in the Dead.—There is no special case in law wherein the *fact of pregnancy* requires to be verified after the *death* of a woman; but an examination may be necessary in order to determine the identity of a body, or to rescue the reputation of a woman from a charge of unchastity. The discovery of an embryo or fœtus with its membranes in the uterus, or any other product of conception, such as a hydatid mole or lithopædion, would of course at once solve the question, should the necessity for an examination occur; and the practitioner will remember that, even supposing many years to have elapsed since interment, and the body to have been reduced to a skeleton, still if the fœtus had reached the period at which ossification takes place, traces of its bones may be found amidst the bones of the woman. In examining the body of a woman long after death, for the purpose of determining whether she was or was not pregnant at the time of death, it may be borne in mind that the unimpregnated uterus undergoes decomposition much more slowly than other soft organs, with the exception of the kidney (Vol. I., p. 307).

In the case of a woman who had been missing for a period of nine months—whose body was found in the soil of a privy, so decomposed that the bones separated from the soft parts—the uterus was of a reddish colour, hard when felt, and its substance firm when cut. The fact was of importance. It was alleged that the deceased was pregnant by a young man, and that in order to conceal her condition he had murdered her. From the state of the uterus, Casper was able to affirm that this organ was in its virgin condition, and that the deceased was not pregnant at the time of her death ("Ger. Leich. Oeffn.," vol. 1, p. 93).

It may happen that the appearances in the uterus are sufficient to create a strong suspicion that the woman had been pregnant, but the ovum, embryo, or fœtus may have been expelled: in this case several medico-legal questions will arise in reference to delivery.

In cases of recent pregnancy the site of the placenta is also complete evidence; for other signs *vide* "Signs of Delivery," next sub-section.

MEDICAL EVIDENCE OF PREGNANCY.

The signs of pregnancy from a medical point of view are commonly divided into the presumptive or probable and the certain, and possibly this is the best way to consider them. They can only be briefly sketched here; for fuller details the reader is referred to text-books on midwifery.

Presumptive or Probable Signs of Pregnancy.—*Cessation of Menstruation.*—It is well known that in the greater number of healthy females the menses cease when conception has taken place, but, on the one hand, women who have never menstruated have been known to become pregnant, and, on the other, women have been known to menstruate during pregnancy (*B. M. J.*, 1, 1903, p. 963). Again, either menstruation or its suppression may be only feigned, for in either case the woman probably has strong motives for asserting that which is not. To discuss the innumerable causes besides pregnancy which may cause the menses to cease would be out of place here, but will be found in any good work on midwifery or gynæcology.

For medico-legal purposes where an opinion on oath is required, the menses, either suppressed or continued, may be left without further comment.

Morning Sickness, although a frequent phenomenon in the early stages of pregnancy, is so frequently caused by other conditions (alcohol, for example) that it, too, may be dismissed without further notice.

Changes in the Breasts.—These need not be described in full, nor criticised; they essentially consist in increased growth with increased physiological activity. The editor has under "Virginity" mentioned a case where a girl who was certainly not pregnant was much troubled with secretion of milk from the breasts.

Enlargement of the Abdomen.—This, like the foregoing, is *primâ facie* suggestive of pregnancy, but, like them, owns so many other causes that it cannot be here discussed in full with any advantage. It is sufficient to say that any well-educated medical man could hardly fail to differentiate a pregnant uterus from other causes of a prominent abdomen, especially if an anæsthetic were given before examination; at the same time it must be admitted that mistakes have been made, not altogether infrequently, in clinical practice, so that care is needed in the differential diagnosis.

Quickening.—Quickening is the name applied to peculiar sensations experienced by a woman about the fourth month of pregnancy. The symptoms are popularly ascribed to the first perception of the movements of the fœtus, which occur when the womb begins to rise out of the pelvis; and to these movements, as well as probably to a change of position in the womb, the sensation is perhaps really due. The movements of the fœtus are perceptible to the mother before they are made evident by an external examination.

In olden days quickening was rather important, because the law demanded proof that a woman was "quick with child." This ancient piece of pedantry has now disappeared, and we need only mention here that the period at which it occurs is very variable in a genuine pregnancy, and that women practise much self-deception about its occurrence in spurious cases of pregnancy. For further details the reader is referred to manuals of midwifery.

Softening of the Cervix is a fairly constant feature in pregnancy, but it does not usually occur till pregnancy has advanced to about six months, by which time other certain signs are likely to have appeared.

Uterine Souffle.—A blowing sound heard just over the pubes, by means of the stethoscope; it is constant in pregnancy, but is also heard in other conditions. It is synchronous with the maternal pulse.

Certain Signs of Pregnancy.—*Rhythmical Contractions and Relaxations of the Uterus.*—These are not preceptible always, but when felt are proof of pregnancy, for they occur with no other condition. It is seldom that five or ten minutes elapse without these contractions being perceptible to the hand resting on the abdomen. At one time a tumour is plainly defined, more or less firm, and resisting; in a short time this becomes flabby, and sometimes not to be found: again the uterus contracts, and the tumour becomes as apparent as before.

Movements of the Child.—These are not always to be appreciated, but they cannot, when they occur, be mistaken for anything else, and are undisputable evidence of a child living at the time of examination.

Sounds of the fœtal heart.—By the application of the ear or a stethoscope to the abdomen, at or about the fifth month of pregnancy (rarely earlier), the pulsations of the fœtal heart may be recognised and counted. These pulsations are not synchronous with those of the arteries of the mother; they are much more rapid, and thus with care it is impossible to mistake them. Their frequency is in an inverse ratio to the state of gestation, being usually 160 at the fifth, and 120 at the ninth month. Rarely, however, the fœtal pulse may descend to 80 or even 60 beats per minute. This sign, when present, not only establishes the fact of pregnancy beyond all dispute, but shows that the child is living. The sound of the fœtal heart is, however, not always perceptible: when the child is dead, of course it will not be met with; but its absence is no proof of the death of the child, because the hearing of the pulsations by an examiner will depend very much upon the position of the child's body, the quantity of liquor amnii, and other circumstances. Thus the sounds may be distinctly heard at one time, and not at another: they may be absent for a week or fortnight, and then will reappear: so that although their presence affords the strongest affirmative evidence, their absence furnishes uncertain negative evidence; and several examinations should be made in the latter case, before an opinion is formed. The earliest time at which the pulsations may be heard has been stated to be about the fourth month, but they will be best heard after the sixth month. The reason why the sounds of the fœtal heart are not always perceived is owing not only to change in the position of the child, but to the vibrations having to traverse the liquor amnii and the soft layers of the skin of the abdomen. The presence of much fat in these layers intercepts them. The point where the sounds can be most readily perceived is commonly in the centre of a line drawn from the navel to the anterior superior spinous process of the ilium on either side—perhaps most commonly on the left.

Ballottement.—A well-marked test of pregnancy is the shock perceptible to the finger on giving a sudden impulse to the child through the neck of the uterus. The child floating in the liquor amnii is driven by the impulse against the other side of the uterus, and it is this blow against the womb that is perceptible to the hand lying on that organ.

As all certain signs refer to an advanced stage, a witness may be asked, what are the unequivocal indications of pregnancy *before the fifth and sixth months?* The answer to this question is of little moment to a medical jurist, since he is rarely required to give an opinion at so early a period. In all *legal* cases, when pregnancy is alleged or suspected, it is the practice for a judge or magistrate, on a representation being made by a medical witness, to postpone the decision one, two, or three months, according to the time required for obtaining *certain evidence.* The most experienced practitioners agree that before the *sixth month* the changes in the neck and mouth of the uterus are of themselves too uncertain to enable an examiner to form a certain opinion; and, *à fortiori,* it is impossible to trust to external signs alone. A skilled gynæcologist may be able, even by the end of the second month, to give a decided opinion one way or the other, if he have repeated opportunities for examination at intervals; but as most practitioners do not belong to this class, it is well to state plainly that only a problematical opinion can be given, and to ask for an adjournment of the csse, for it must be remembered that an opinion has to be given on oath, however unfair such a proceeding may be (*vide* Vol. I., p. 47).

Continental gynæcologists claim to diagnose pregnancy within a week or two of conception ("Keiffer Bull. de la Soc. Belge de Gynec. et d'Obst.," vol. xiv., 1904), but such refinements cannot be admitted to a medico-legal work until they have stood a much longer test of time as to their infallibility.

THE DURATION OF PREGNANCY.

This naturally falls under three headings:—

1. What is the average period of gestation?

2. To what extent can this period be shortened and yet a viable child be born?

3. To what extent can gestation be prolonged?

Before discussing these in full it is well to briefly refer to the unusual forms of pregnancy known as **superfecundation and superfœtation.**

For a fuller discussion the reader is referred to works on midwifery.

Superfecundation is the fertilising of two ova which have escaped at the same act of ovulation, but fertilised by separate acts of coitus: the possibility of such an occurrence is admitted by all authorities to explain some cases of natural twins, etc. There can be no absolute proof of its occurrence if we choose to assume that an ovum can divide (which is certain), and that each half can develop into a well-made fœtus (which is uncertain, though possible, or even probable).

Superfœtation is the fertilising of two ova which have escaped at different acts of ovulation; the second ovum is fertilised and begins to develop before the first one has left the uterus. Up to the third month, when the decidua vera unites with the decidua reflexa, we must admit that it is a physical possibility for spermatozoa to reach a second ovum, but the doubt is whether ovulation is suspended so soon as one ovum is impregnated, *i.e.*, during the whole time of pregnancy. Authorities are much divided on the subject, and the reader is referred to works on obstetrics for its discussion.

This subject has been said to involve "not only the conjugal fidelity of a wife, but the disposition of property, and much of the comfort and happiness of society." Its importance to a medical jurist appears to have been here considerably exaggerated. Only one legal case involving this question is to be met with in the judicial records of this country (*vide* below, Paxton's case); but few in reference to this state are ever likely to occur which would create the least practical difficulty. If we admit that a woman may, during marriage, present such a deviation from the common course of nature as to produce two perfectly mature and fully-developed children, the one three or four months after the other, how can such an event be any imputation on her fidelity? Superfœtation, if it occurs at all, may occur as readily in married life, during connubial intercourse, as among unmarried women. The following appears to be, however, a possible case wherein a medical opinion might be required respecting this alleged phenomenon.

A married woman, six months after the absence or death of her husband, gives birth to an apparently mature child, which dies: three months afterwards, and nine months after the absence or death of her husband, she may allege that she has given birth to another child, also mature.

A question may arise, whether two mature children could be so born that the birth of one should follow three months after the birth of the other; or whether this might not be a case, by no means uncommon, of twin-children—the one being born prematurely, and the other at the full period.

The full consensus of medical opinion is that such a case is distinctly possible.

Admitting that both the children when born were mature, and therefore that it was a case of superfœtation, the first delivery must have taken place in the presence of witnesses, and it would then have been known whether another child remained in the womb or not. If the two children were born within the common period of gestation after the absence or death of the husband, then their legitimacy would be presumed, until the fact of non-access was clearly established. The mere circumstance of their being apparently mature, and born at different periods, would *per se* furnish no evidence of their illegitimacy. On the other hand, if one or both of them were born out of the ordinary period, then, according to the evidence given, they might or might not be pronounced illegitimate. The law therefore appears to have no sort of cognisance of the subject of superfœtation, as such: it is generally merged in the question of protracted gestation.

Cases of different coloured children in the same pregnancy, by different coloured fathers, prove the possibility of superfecundation.

Paxton met with a case in which a question of infanticide arose out of the supposed condition of superfœtation (*Glasgow Med. Jour.*, January, 1866). A maid-servant, æt. 20, was delivered in secrecy. When questioned she denied that she had been pregnant. On examination, however, the appearances were all those of recent delivery. The uterus was felt as high as the umbilicus. At the time of the examination there was no lochial discharge. The medical opinion given was that she had been delivered within three days. She now changed her line of defence, and stated that she had not only been pregnant, but still was so. Another examination showed that this was correct. The presence of a fœtus in the uterus was proved not only by the ballottement, but by the placental murmur, and the uterus was found to be larger than at the former examination. On the other hand, the fact that she had been delivered twelve days before was proved at the first examination by the relaxed state of the vagina, the open orifice of the uterus, the enlargement of the breasts, the great loss of blood, with a copious secretion of milk, the abundant lochial discharge, and the subsequent marked diminution of her abdomen. These facts were only reconcilable with the delivery of a child or some product of conception, and were not consistent with merely a threatened abortion of a fœtus then in the womb. In reference to a previous delivery, neither child nor placenta could be discovered; but the woman admitted to a fellow-servant that she had disposed of the body. After the lapse of three months she gave birth to a stout, healthy child. This woman had had intercourse with two men, and Paxton regarded the case as one of superfœtation, or a twin-conception. She was charged with the murder of the child of which she had been first delivered; but as the body was not forthcoming, there was no evidence to establish the crime. Owing to this there was a failure of proof to show that one child had been born mature three months before the other. The first delivery might have been the body of an aborted immature twin, or of a blighted ovum (see also a case by Ramsbotham, *Med. Times and Gaz.*, 1858, 2, p. 616).

The following case of superfœtation is related by Dr. Martin, of Woolston:—"On May 25th I was called to see a child, aged three weeks. While I was in the house, the mother mentioned that she had miscarried on January 1st of this year, and that the midwife who had attended at that time had estimated the fœtus then born as a child of between three and four months. According to these dates, the child I saw was born four months and a few days after the miscarriage. On questioning the woman she told me that she had felt the movements of the present child *in utero* one month after the miscarriage" (*B. M. J.*, June 21st, 1893).

The subject of superfœtation has been examined in another aspect by Bonnar; and some of the facts which he has brought forward are not consistent with the theory of the births of twins at different intervals ("A Critical Inquiry regarding Superfœtation, with Cases," 1865).

THE AVERAGE PERIOD OF GESTATION.

As a matter of strict fact, this is of very little medico-legal interest, for in cases of dispute it is not what is the average, but what is the possible duration of pregnancy, that is the question. It is, however, well to quote the generally accepted opinion, and to consider briefly the causes of difficulty in accepting a fixed period.

It may, then, be stated once for all that the usually accepted *average* is 280 days, which is the period allowed in ordinary clinical tables provided for medical use.

The difficulties in the way of exact determination are first and foremost the impossibility of fixing the exact moment of impregnation; the most exact scientific observations on this point with which the editor is acquainted are the following of Professor Bossi, of Genoa (*Gazzetta degli Ospitali*, April 8th, 1891), who publishes the result of a long series of observations made with a view to settle these disputed questions. He closely watched several classes of women, such as newly-married persons, and wives of sailors who lived for more or less definite intervals apart from their husbands. Lastly, he noted the effects of what is termed artificial impregnation. This process consisted in transferring spermatic fluid, shortly after coitus, into the uterine cavity or simply into the posterior vaginal fornix from a less favourable position in the genital tract. He undoubtedly met with marked success, and his researches have led him to the following conclusions:—(1) Fecundation, whether natural or "artificial," takes place within the first few days after a menstrual period. This implies that the encounter of spermatozoa with ova occurs neither before nor during the period of menstrual flow, but after the end of menstruation. (2) To avoid failure the aid of art should be invoked on the very day on which the "show" ceases or during the three following days. (3) Spermatozoa lodged in the posterior fornix, or *nidus seminis*, may remain alive there for even so long as seventeen days—certainly between periods, and in some cases during a period. (4) Hence it is probable that in cases of fecundation before a menstrual flow the spermatozoa have remained living in the fornix till after the period, and have not ascended the uterine cavity and the Fallopian tubes (*sic*) until the proper time has arrived for meeting the ovum. (5) The fact that spermatozoa may live so long in the posterior fornix—even through a menstrual period—is of importance from a medico-legal standpoint.

Of these conclusions, the one which seems to be of paramount importance is that which proves that spermatozoa can live for seventeen days in the vagina. As to how they spend their time there we are (in the human race at any rate) supremely ignorant; we only know as the result of facts that, at some time or other, one (or more) of them makes its way into the uterus or up the Fallopian tube or even still further, as far as the ovary (tubal pregnancy is common enough, and actual ovarian pregnancy has been asserted—? proved—to occur).

This fact alone would vitiate any calculation, so far as the actual definite duration of gestation from impregnation to delivery is concerned, to the extent of at least seventeen days.

A theory more ingenious than convincing has been put forward that parturition occurs at some anniversary of the menstrual period. Numerous facts tend to show that, notwithstanding the general suppression of the menses, there is great excitement of the uterine system at what would have been, in the unimpregnated state, the regular menstrual periods. Sometimes this really amounts to a periodical discharge of blood. There is also great reason to believe that abortion takes place more readily at these than at other periods. Hence some accoucheurs are inclined to consider that the duration of pregnancy is really a multiple of the menstrual period; and that in the majority of women it will occur at what would have been the tenth menstrual period, or forty weeks from the date of intercourse and supposed conception; and according to the degree of excitement of the uterine system, the child may be expelled at a period earlier or a period later than that which is assigned as the more usual natural term.

Whatever be the value of this theory, it has many exceptions, and need not here be further discussed.

There is no reason to believe that the *sex of a child* has any direct influence on the length of the pregnancy. It has been stated that gestation was longer with male than female children; and evidence of this kind was tendered in the Gardner Peerage case. A medical witness then asserted that the average period was 280 days for a female and 290 days for a male child. The Solicitor-General inquired—Supposing the child is an hermaphrodite, what then is the time? The witness said that he would "take between the two." It is not observed that children labouring under sexual deformity are born earlier or later than those in which the sexual organs are perfectly developed. As an answer to this hypothesis, it may be observed that of Murphy's two protracted cases (*post*, p. 60) the one was a female and the other a male child.

Another difficulty which should be briefly alluded to is that which may be said to be based on Professor Bossi's observations above—viz., the difference between insemination (or the act of sexual intercourse) and impregnation or conception (the union of sperm and germ). The date of the one is, in cases of proved single intercourse, known; the other, in every case, only guessed at. Some women assert that they can fix it, but their evidence would not bear much cross-examination in details, and it must be admitted that we know nothing about it. In the first place, the relationship between menstruation (external appearances of blood) and ovulation (the escape of an ovum from the ovary) is very variable in time and, some observers would go so far as to say, in physiological causation; again, it is known (at least by the presence of two *corpora lutea*) that two ova may escape from the ovary within a short time of one another; they may make very different rates of progress into the uterus, and who is to say whether it is one of these, or which, or even if it is the ovum of one period or the next, that becomes fecundated? It may be unhesitatingly asserted that we do not know how long an interval, if any, there may be between insemination and impregnation.

The popular method (upon which, however, the 280 days' duration is based) of counting from the cessation of menstruation is open to very wide fallacies for the reasons we have alluded to. One case may be here inserted in illustration (if only for its comical aspect), reported by Reid.

A patient, who had already borne a child, had her last menstrual appearance on July 8th; she quickened, *she thought*, about November 7th, and her confinement was expected about April 12th. The lady's mother travelled 400 miles in order to be present at the accouchement; and as day after day passed over without its occurrence, much uneasiness was felt by both parties, and Reid was sent for repeatedly to allay their fears and explain the cause of this unexpected delay. The dates were all again carefully compared, and July 8th was fixed on as the proper catamenial point to start from. Reid could only suggest that impregnation had occurred at a later period of the interval than had been supposed; and at length, on putting the question if the lady's husband had been at home on July 9th, he found that he had not returned from an excursion into Scotland until the 23rd of that month. The explanation was now very easy, and the lady was confined on April 28th. In this case 294 days had elapsed since menstruation, but 279 only from the earliest possible time of conception (*Lancet*, 1853, 2, p. 207).

That of reckoning from quickening is even more fallacious.

The editor has omitted as useless the masses of tables and statistics given in former editions of this work quoting opinions in regard to a useless average.

To what Extent can Pregnancy be Shortened and yet a Viable Child be Born.

We here at once enter upon a subject which may be of the last degree of importance, and upon which well-authenticated cases are practically the only means of deciding. Their evidence must be fully considered. Great mistakes have arisen in the calculation of the period by the use of the word "month"—some intending by this a *lunar* and others a *calendar* month. Nine lunar months would be equal to 252 days, while the average of nine calendar months would be 274 days, and would vary from 273 to 276 days—the period varying according to the particular months of the year over which the pregnancy might extend. To prevent mistakes, or that misunderstanding of evidence which has so frequently arisen, it would be advisable that medical witnesses should always express the period of gestation in weeks or days, concerning which there can be no misunderstanding: it would be also proper to adopt the plan of always commencing the calculation from the period of the last cessation of the menses, rather than from two weeks later. The latter rule is often followed, and this is another cause of confusion.

Premature Births. Short Periods of Gestation.—We may regard all births before the thirty-eighth week as premature, and all those which occur after the fortieth week as protracted cases; and one great point for a medical witness to determine is, whether the characters presented by a child correspond to those which it should present, supposing it to be legitimately born. When the birth is premature, this sort of corroborative evidence may be sometimes obtained; because, assuming that there has been no access between the parties before marriage, children born at the fifth or sixth month after marriage cannot, if the offspring of the husband, present the characters of those born at the full period. It is not so with protracted births, for children are not more developed in protracted cases than they are in those which occur at the usual period. This would lead to the inference that when a child has reached a certain stage of development it ceases to grow —a view which is borne out by the observations of Rüttel (Henke's *Zeitschr.*, 1844, p. 247). He observed that the size of a child did not increase in proportion to the length of gestation. In protracted human and animal gestation the offspring is not remarkable for size and weight. In both cases robust mothers have had small children, and small mothers strong and sometimes unusually large children. Murphy states that he met with a fully-developed child which was born after a gestation of only 251 days (*Lancet*, November 30th, 1844, p. 284). For an account of the characters presented by children at different uterine ages, see "Age," Vol. I., pp. 194 *et seq.*

In judging from marks of development on the body of a child, we must make full allowance for the exceptions to which they are liable. The nearer the supposed premature delivery approaches to the full period of gestation, the more difficult will be the formation of an opinion. Although the characters of a seven-months child, as a general rule, are usually well marked, and may be known by common observation, it is not possible to distinguish with absolute certainty a child born at the eighth from one born at the ninth month. Burns observes that gestation may be completed, and the child perfected to its natural size, a week or two sooner than the end of the ninth month; and other accoucheurs corroborate this view. In a series of cases which occurred to Devilliers, the following were the weights of children born at the respective periods:—

229 days .	. 4·60 pounds.	270 days .	. 6·8 pounds.
246 ,, .	. 4·88 ,,	272 ,, .	. 7·3 ,,
257 ,, .	. 6·68 ,,	283 ,, .	. 6·0 ,,
267 ,, .	. 7·71 ,,		

Hence the weight of a child born in the fortieth week may be less than that of another born in the thirty-seventh week of gestation. The weight in the third case may be taken as the average weight of a mature child, and the delivery took place *three weeks* before the usual period (see *Gaz. Med.*, 4, March, 1848, p. 168). Thus, then, a child born at the eighth month may be the offspring of the husband—at the ninth month, of an adulterer; but medical facts could not enable a witness to draw any distinction. It is here that moral proofs are necessary, for without these the legitimacy of a child in such a case could not be successfully disputed. With respect to twin-children, the greatest differences are sometimes observed. In a case which occurred to West, the first child born weighed only a pound and a half; the second weighed more than three pounds, and both lived several hours. In another premature twin-case which occurred to the same gentleman, one child weighed two pounds and a quarter, and the other two pounds and three-quarters (*Med. Times*, February, 1850, p. 147).

The fact that a child has had the strength to survive its birth for a certain period has been supposed to furnish additional evidence of maturity; for it is well known that under a certain age children are not born living, or, if living, they speedily die. Therefore it has been argued, if a child born at the fifth or sixth month after the first cohabitation be born living, or survive, this should, *ipso facto,* be taken as a proof of its illegitimacy. The following remarks will, however, show that an argument of this kind is liable to be overstrained:—

Viability.—According to the English law, it is not necessary that a child, when born, should be capable of living, or *viable,* in order that it should take its civil rights. Thus it may be born at an early period of gestation; it may be immature and not likely to survive; or again, it may be born at the full period of gestation, but it may be obviously labouring under some defective organisation, or some mortal disease, which must necessarily cause its death within a short time after its birth. Fortunately, these points are of no importance in relation to the right of inheritance: an English medical jurist has only to prove that there was some well-marked physiological sign of *life* after birth ("Live Birth"); whether the child were mature or immature, diseased or healthy, are matters which do not at all enter into the investigation. In this respect our law appears to be more simple and just than that which prevails in France. By Art. 725 of the French Code, no child that is born alive can inherit, unless it is born, as the law terms it, *viable.* The meaning of this word is not defined by the law itself, and there are probably no two lawyers or physicians in that country who place upon it the same interpretation. The French law seems to intend by viability in a new-born child that it should have breathed, and be capable of living out of the womb of its mother and independently of her; also, that it should be capable of living for a longer or shorter period after its birth (Devergie, vol. 1, p. 700; Briand, p. 173). Géry defines it to be the aptitude or fitness of a child to maintain extra-uterine life. Most French writers agree in this, but great difficulties occur in applying the principle to special cases, or in fixing upon a standard by which this fitness can be measured. Géry does not assign any definite uterine age for viability. The 180 days allowed by the French Code are not in his view sufficient. Another month should be added, making the period for viability 210 days, or about the end of the seventh month. It is clearly impossible to fix a precise date, for all children do not attain the same degree of development or aptitude for living, at the same uterine age ("Ann. d'Hyg.," 1871, vol. 1, p. 239). The question of viability or non-viability in reference to new-born children has been investigated by Bohm (Horn's *Vierteljahrsschr.,* 1866, 2, p. 80; also 1865, 2, p. 264).

It may at first sight appear to be inconsistent with justice that a child which is born immature or labouring under disease, owing to which it cannot long survive its birth, should possess the same rights of inheritance as one which is born mature and perfectly healthy; but this evil to society is of far less magnitude than the adoption of a system which must constantly lead to subtle casuistical distinctions, and thereby create error and confusion. So long as there is no well-defined line between a child which is considered capable of living and one which is not, gross injustice must necessarily be inflicted by any rule of law similar to that which is admitted in the French Code.

Earliest Period at which a Child may be born living.—The question now to be considered in reference to English practice is, What is the *earliest period* at which a child can be born living, and with a capacity to live after its birth and attain maturity? It is universally admitted that children born at the seventh month of gestation are capable of living, although they are more delicate, and in general require greater care and attention to preserve them, than children born at the ninth month. The chances are, however, very much against their surviving. It was the opinion of William Hunter, and it is one in which most modern authorities concur, that few children born before *seven calendar months* (or 210 days) are capable of living to manhood. They may be born alive at any period between the sixth and seventh months, or even, in some instances, earlier than the sixth; but this is rare, and, if born living, they commonly die soon after birth. There is one case on record of a child having been born living so early as the *fourth month* of gestation (*Brit. and For. Med. Rev.*, vol. 2, p. 236); and another, in which a woman was delivered at the fourth and a half month of pregnancy:—

Maisonneuve saw the woman two hours after delivery; he then found the fœtus in its membranes, and on laying these open, to his surprise it was still moving. He applied warmth, and partially succeeded in restoring it, for in a few minutes the respiratory movements were performed with regularity, but in spite of the establishment of breathing the child died about six hours after its birth (*Jour. de Méd.*; *Med. Gaz.*, vol. 39, p. 97).

Carter attended a woman who had an abortion when not more than *five months* advanced in her pregnancy. The fœtus cried slightly directly it was born, and during the half-hour that it lived unsevered from its mother, it frequently tried to breathe. The body of the fœtus was one foot in length, and it weighed twenty and a half ounces. It appeared to be perfectly formed. From accurate information he was satisfied that the woman had not passed the fifth month of pregnancy.

In two instances of abortion, about the *fifth* month, Davies noticed that the fœtus showed signs of life after its birth, by moving its limbs (*Med. Gaz.*, vol. 40, p. 1022); and in the following case a child born at the *fifth* month survived upwards of twelve hours:—

A woman in her second pregnancy and in the 147th day of gestation had severe flooding with rupture of the membranes. Labour occurred on the following night, when a small but well-formed fœtus was expelled giving no other indication of life than a feeble action of the heart, and a strong pulsation in the umbilical cord. It was resuscitated, and *cried* as strongly as a child born at the full period of pregnancy. It weighed less than two pounds, and was exactly twelve inches in length. It swallowed some nourishment, but died about twelve hours after birth. The pupillary membranes of the eyes were entire; the testicles had not descended; the head was well covered with hair. The length and weight, as well as the presence of hair, indicated a fœtus between the sixth and seventh months; but as it is asserted that the period of gestation is accurately given, this must be regarded as an extraordinary instance of premature development. There was clearly nothing in the organisation of this child to have prevented its growing to the age of maturity; in other words, it was *viable* (*Med.-Chir. Rev.*, July, 1844, p. 266).

Another case is reported, in which a child born at five and a half months survived its birth between three and four hours (*Med. Gaz.*, vol. 19, p. 563). Routh reports a case in which a child born at this uterine age, *i.e.*, five and a half months, lived for eighteen days. The child was very small and weakly: its weight was not taken. The duration of pregnancy was twenty-two weeks and two days, or five lunar months and sixteen days. The child died on the eighteenth day after its birth ("Obst. Trans.," 1872, p. 132).

On a trial for child murder (*R.* v. *West*, Nottingham Lent Ass., 1848), a midwife was indicted for causing the death of a child by bringing about the premature delivery of a woman when she was between the fifth and sixth months of pregnancy. The child in this instance lived five hours after its birth. Capuron mentions an instance in which a child was born at the six and a half month of pregnancy; and at the time he reported the case, it was two years old and enjoyed excellent health. In another instance a child was born at the same period and lived to the age of ten years ("Méd. Lég. des Accouch.," pp. 162, 208). (See another case, *Med. Gaz.*, vol. 32, p. 623.) Capuron considers that a child born at the 180th day, or at the sixth month after conception, may be sufficiently mature to live, *i.e.*, that there would be no reason to presume it was illegitimate merely because it had survived its premature birth. On the other hand, if born before the sixth month, with sufficient maturity to live, this fact, although by no means a proof, affords, in his opinion, a strong presumption of its illegitimacy. Of eight cases of children born living (by abortion) at the sixth month, Whitehead states that seven perished within six hours after birth, and only one attained to the age of ten days ("On Abortion," p. 249).

Rüttel attended a married woman, who was afterwards delivered of a living child in the *fifth month* of her pregnancy: the child survived its birth for twenty-four hours. He delivered another woman of twins, in the *sixth month* of her pregnancy: one was dead, and the other continued alive for three hours, its life being indicated only by the visible pulsation of the heart—there was no perceptible respiration. This fact corroborates the remarks made elsewhere as to life without active respiration (see "Infanticide"); it has also an immediate bearing on the proofs of life in reference to tenancy by courtesy. (Cases of *Fish* v. *Palmer*, and *Brock* v. *Kelly*.) In another instance of the birth of male twins, at the *sixth month*, each weighed three pounds. Rüttel saw them a year after their birth, and they were then two healthy, strong children (Henke's *Zeitschr. der S. A.*, 1844, p. 241).

Barker met with a case in which a female child was born at the 158th day of gestation, or twenty-two weeks and four days after intercourse. The size and weight of the child corresponded with the period at which it was born: it weighed one pound, and measured eleven inches in length. It had only rudimentary nails, and very little hair on the back of the head; the eyelids were closed, and remained closed until the second day; the nails were hardly visible; the skin was shrivelled. The child did not suck properly until after the lapse of a month, and did not walk until she was nineteen months old. When born, she was wrapped up in a box, and placed before the fire. Three and a half years afterwards this child was in a thriving state and healthy, but small, weighing twenty-nine pounds and a half (*Med. Times*, 1850, 2, pp. 249, 392). Annan reported a case in which a child was born between the end of the sixth and middle of the seventh month, and lived for a period of four months and eight days. It weighed a pound and a half when seven days old (*Med. Times*, September 9th, 1848, p. 304). In a case which occurred to Outrepont (Henke's *Zeitschr.*, vol. 6), there was the strongest reason to believe that gestation could not have exceeded twenty-seven weeks. The child (a male) weighed, when born, one pound and a half, and was thirteen and a half inches in length. The skin was covered with down and much wrinkled; the limbs were small; the nails appeared like white folds of skin, and the testicles had not descended. It breathed as soon as it was born, and by great care its life was preserved.

It is singular that its development was very slow until it had reached a period which would have corresponded to the forty-second week of gestation. Outrepont saw the child when it had attained the age of eleven years, and it then appeared to be the size of a boy of eight years. The only remarkable point about the case is the length of time which the child lived. In one case (*Lancet*, 1851, 2, p. 177), a child born at six months and ten days was thriving satisfactorily when four months old (see also *Med. Times*, February 16th, 1850, p. 129). A gentleman of a well-known family in Scotland was undoubtedly born before the seventh month. When first born the child weighed three pounds. As a child he was not expected to live, but he grew up a small, strong man, capable of great mental and bodily exertion. He died from natural causes at about the age of forty-two. His head throughout life was large in proportion to his size.

Hence it is established that children born at the seventh, and even at or about the sixth month, may be reared, and that the fact of their surviving for months or years cannot be taken as evidence of illegitimacy. In forming our judgment on these occasions, we are bound to look less at the period at which a child is born than at the marks of development about the body. Bonnar published a tabulated view of 112 cases of premature births of living children—the dates of gestation extending from the 120th to the 210th day. Among these cases 35 children died within the first twenty-four hours; 13 more before the completion of one week; 1 in six weeks; 4 in four months. The following lived, or were living at the date of the report: 1, seven and a half months; 8, from one to two years: 1, three and a half years; 5, from ten to fifteen years; 6, to adult age; 5 lived, not stated how long ("Critical Inquiry regarding Superfœtation," 1865, p. 13).

The medico-legal bearing of these facts will be seen from the following case, known as the Kinghorn case:—

In 1838 an investigation (*fama clamosa*) took place before one of the Presbyteries of Scotland, in reference to certain reports which had been circulated to the prejudice of a minister of the district. His marriage took place on March 3rd, 1835, and his wife gave birth to a female child on August 24th following—*i.e.*, 174 days, or nearly *six calendar months* after the marriage—and the child continued to live until March 20th, 1836. When born it was very weak, and according to the evidence of the accoucheur, and others who saw it, was decidedly immature. The birth of a living child, together with the fact of its surviving for so long a period, led, however, to the report that there must have been intercourse between the parties previous to marriage: it was contended that the period was too short for the child to have been begotten in wedlock. Hamilton, on being applied to by the Presbytery, said that his own experience was opposed to the probability of a child born at the sixth lunar month surviving (the time in this case was six lunar months and six days); but he referred to two cases in which children born under similar circumstances had survived their births for a long period. In one the lady was delivered within five lunar months (twenty weeks) after the marriage, and Pitcairn and others gave it as their opinion that it had been begotten within wedlock: in the other, a woman gave birth to a child nineteen weeks after conception, and it lived a year and a half. Thatcher, who examined the child, in the case here reported, nineteen days after its birth, gave it as his opinion that it might have been begotten on or after March 3rd; and the circumstance of its having been reared, in the premature state in which it was born on August 24th, was no objection to this opinion. He considered the complaint made against the minister groundless. The case went through several appeals, and was not finally decided until May, 1839, when the libel was found *not proven*, and the defendant was absolved from censure.

Many medical witnesses gave evidence on the occasion; the majority of them were strongly in favour of this having been a legitimate and premature birth (see *Med. Gaz.*, vol. 17, p. 92; also *Med.-Chir. Rev.*, vol. 31, p. 424).

Although not connected with the medical part of the case, it should be observed that the character of the parties was free from all suspicion, that no concealment had been practised by them, and that no preparation had been made for the early birth of the child. There were, it is true, *unusual marks of development* about the child, considering the early period of its birth; yet these were not sufficient, any more than the fact of its surviving, to induce the belief that it had been begotten out of wedlock. One case has already been mentioned in which a child, born at a still earlier period, survived several hours, and others in which children born rather later lived for two and ten years. It would be in the highest degree unjust to impute illegitimacy to offspring, or a want of chastity to parents, merely from the fact of a six-months child being born living and surviving its birth. There are, indeed, no justifiable medical grounds for adopting such an opinion—a fact clearly brought out by a question put to Campbell, the chief medical witness in favour of the alleged ante-nuptial conception. In his examination-in-chief he admitted that he had himself seen the case of a six-months child who had survived for *several days*. He was then required to say whether he could assign any reason why, if after such a period of gestation it is possible to prolong life for *days*, it should not be possible to extend it to *months*. He could give no satisfactory reply.

The great injury which may be done by speculative medical opinions, such as those given against the chastity of the parties concerned in these proceedings, will be apparent from the record of a case which occurred to Halpin in 1845.

> A healthy woman, æt. 34, the mother of five children, was delivered in the *sixth month* of her pregnancy of a female child. It was rolled in flannel and laid in a warm place. Contrary to expectation the child survived, sucked vigorously, and was healthy in every respect. The ossification of the bones of the head was very imperfect, and the sutures were broad enough to admit of the middle finger being laid between them, while the fontanelles were of correspondingly large size. The weight of the child, on the fourth day after birth, was two pounds thirteen ounces, and on the thirty-fourth day three pounds seven ounces. The child was alive and well when last seen on March 4th, *i.e.*, four months after birth; she then weighed eight pounds eight ounces. After this Halpin lost sight of her, as the mother left that part of the country (*Dublin Quart. Jour.*, May, 1846, p. 563).

If the facts of these cases be compared with those of the Kinghorn case it will be seen that there were no just medical grounds for the allegation that in the latter the child had been begotten out of wedlock. In these two cases, six-months children were living and healthy after four months and three and a half years respectively: in the Kinghorn case, it was supposed that the child must have passed the sixth month of uterine life, because it had survived seven months. In Halpin's case the child, four days after birth, weighed two pounds thirteen ounces—a six-months child rarely exceeding two pounds: in the Scotch case it was considered that it must have been much beyond the sixth month, because a fortnight after its birth it weighed three pounds. These cases should be borne in mind when much reliance is placed upon appearances presented by children as positive evidence of the stage of uterine life which they are supposed to have attained.

Evidence from the State of Development.—The fact that a child born at nine months is small, and resembles in size and weight a seven or eight-months child, cannot be taken as proof of illegitimacy. It has been already stated that children born at the full period vary considerably in size and weight; yet, although small, there are commonly about them the appearances of *complete development*. This is especially apparent in the features. If there is a general want of development of the body, and if certain fœtal peculiarities remain—as, for example, the pupillary membrane, or if, in the male, the testes do not occupy the scrotum—these facts lead to a strong presumption that the child has not reached the full period. On the other hand, when a child is born with the full signs of maturity about it, at or under seven months from possible access of the husband, then there is a strong presumption that it is illegitimate. In the Kinghorn case, the child was more developed than such children commonly are at a similar period of uterine life, but the differences were slight. The great progressive stage of development is considered to be during the last two months of gestation—the changes which the fœtus undergoes are greater and more marked at this than at any other time. The general opinion is that an eight-months child is not with any certainty to be distinguished from one born at the ninth month. If the body of a child is large and fully developed, it would in a general way be considered to have been born at the full period of gestation, and any opinion which had led to the supposition that it was a seven-months child would be attributed to some mistake in the calculation. Beck states it as barely possible that a child born at seven months may *occasionally* be of such a size as to be considered mature, yet he qualifies this statement by the remark that the assertion is most frequently made by those whose character is in danger of being destroyed. The important question, however, is—Has a really seven-months child ever been born so developed as to be mistaken by an experienced person for one that was mature? He adduces no case of this kind in support of his opinion. There can be no doubt of the correctness of his statement, that a *mature* child, born *before* seven full months after intercourse, ought to be considered illegitimate; but it would be difficult to maintain this position, consistently with the above admission, for a child may acquire premature development during the latter half of the sixth as well as at the seventh month.

The following case, in reference to development (at seven months), is well calculated to show the characters of a seven-months child, and to corroborate the views adopted by physiologists respecting the means of determining the period of uterine life which the fœtus may have reached:—

A woman was married on April 7th, 1846, and was delivered of a male child at 7 p.m. on October 19th following, the period of gestation being equal to 195 days, or twenty-eight weeks. The infant cried strongly, and lived until 9 o'clock the following morning; the skin was of a deep pink or rose-colour, beautifully soft, and covered with a fine down. The pupillary membranes were absent, and the pupils were well formed; the nails were complete; the testicles had *not* descended into the scrotum; the length of the body was fifteen inches, and its weight two pounds eight ounces. Its height, and the non-descent of the testicles, at once referred it to a uterine age of seven months.

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In addition to the other characters assigned to children born at the seventh month (see "Infanticide"), it may be observed that children at this uterine age do not so readily take the breast as those which have reach the ninth month, and their power of sucking is much more feeble.

Several cases have occurred in the Divorce Court in which the power of a medical man to form an opinion of uterine age from the appearance of a child at birth, between the *seventh* and *ninth* months, has been seriously called in question. The editor has not heard of a case in which the X rays have been used to determine whether the proper points of ossification are present or not, but doubtless such may occur at any time, and it is certainly a feasible plan for the bones of the upper and lower extremities at any rate, and possibly for other bones.

In *Stone* v. *Stone and Appleton* (1864) the evidence showed that the husband went to India in August, 1859, and that he returned to England in May, 1861, and joined his wife on May 18th. The wife was delivered of a full-grown child on January 2nd, 1862, and the delivery at this date was assumed to be conclusive proof of adultery on her part. She was attended by a medical man, who deposed that in his opinion the child was full-grown, *i.e.*, a nine-months child. Another medical man, who saw the child two or three days after its birth, also considered it to be full-grown. In comparing the date of possible access of the husband with the date of birth, the period of gestation would be 229 days, or seven weeks and two days short of the average period.

The medical question was—Could this be the child of the husband? On the part of the wife, it was alleged that the child was a seven-months child prematurely born, and more than usually developed for its age; and evidence was given to show that in her previous deliveries the children had been prematurely born. The evidence of obstetric experts was also called to prove that any medical opinion based on the maturity or immaturity of the child was of no value. Tyler Smith and Richards were examined, in order to show that children of between seven and eight months were frequently the same in appearance and in size as children born at the full period of nine months, and that any opinion formed from the inspection of a child after its birth as to the date of its conception was very fallacious. They stated that out of a number of cases an experienced physician would be able to say with tolerable certainty in the majority whether a child was a seven, or eight, or nine-months child, but he would probably be mistaken in several cases; and they stated their reasons for their opinions, and mentioned cases in support of them. They also said that illness, bodily weakness, and mental anxiety tended to produce premature delivery, and that a woman who had once been prematurely delivered had a tendency to premature delivery if she afterwards became pregnant. Tyler Smith said that the data on which a judgment could be formed varied so much that no positive or reliable opinion could be given. If the reputation of a lady depended on his opinion, in such a case he should refuse to give it, and if he did give an opinion at all it would be with so many reservations and exceptions that there would be no certainty in it. The jury returned a verdict for the husband, finding that the wife had been guilty of adultery; therefore that this was not the child of the husband, *i.e.*, it was not a seven-months child.

In another case (*Wool* v. *Wool*, March, 1865) the adulterous intercourse was stated to have taken place in May, 1864, and a child was born on January 1st, 1865, giving 246 days (or thirty-five weeks and one day) for gestation, *i.e.*, about five weeks earlier than the average period. The child was 19½ inches long; its weight was six pounds; the hair was fine and long; the nails reached to the finger-ends; the testicles were in the scrotum; the features were well developed; the skin was reddish-coloured, but the muscles were not so firm as in mature children. This degree of development is such as is usually seen in children born at the full time, but at the same time it is not inconsistent with the period of gestation above mentioned—namely, about eight calendar months; it therefore falls under the exceptional cases referred to above.

In *Bromwich* v. *Waters* (Chester Lent Ass., 1863), in which Lee, Ramsbotham, and the author were consulted, the question incidentally arose upon an alleged gestation of 259 days. It was stated that intercourse took place upon November 9th, 1861, and a child was born on July 26th, 1862, a period of 259 days, or thirty-seven weeks. The child had the appearance of a mature child. The counsel for defendant admitted that a child born at this period, *i.e.*, three weeks before maturity, might be as large as one born at the ninth month, but he denied that it would be so perfectly developed in all its parts. This distinction is not generally admitted; and when the question was put to Simpson, who gave evidence at the trial in favour of the defendant, he said that full size was generally combined with full development; and he further stated that it was against all the laws of nature that children should be born full-grown even a fortnight before the usual term of gestation, which he fixed at nine calendar months and a week. According to this view if impregnation took place on November 9th, 1861, the day of probable delivery would be a week after the 9th of the following August, *i.e.*, August 16th. Hence, as the child was actually born in a *mature state* on July 26th, this was three weeks before the usual term; and therefore impregnation from some other person had probably taken place three weeks earlier than the period assigned by the woman (Whalley). Simpson considered it to be as rare that a child should be born full-grown three weeks before the usual period as that a man should attain one hundred years of age. ("Rep. of the Trial of *Bromwich* v. *Waters*," 1863, p. 33.) There are not many medical witnesses, however, who would venture to affirm that in the last three weeks of gestation there are such marked changes in the body of a child as to render this difference in time always perceptible, or who would venture to bastardise a child or convict a woman of adultery because, when born at the 259th day after intercourse, the child had about it the usual appearances of maturity. This would be equal to affirming that variations in size might take place at the ninth but not at the eighth month of gestation. But facts are adverse to the theory. Rüttel has met with several instances in which women have been delivered two and even three weeks before the expiration of the ordinary term (280 days), and the children were as perfectly developed, to all appearances, as other children which had been born at the full period.

In reference to the question of development, we find, on the one hand, some obstetric experts affirming that such a degree of maturity may in some exceptional cases be acquired at *seven months'* gestation as to render it impossible to distinguish the child at birth from one born at the full period; and, on the other hand, obstetric experts of equal experience assert that it is against all the laws of nature that children should be full-grown even only three weeks before the usual term. If the latter view were correct, there could be no difficulty in deciding, from appearances, whether a child had reached the seventh or the ninth month of gestation.

In another part of this work ("Uterine Age—Infanticide") some cases are related which prove that at the ninth month children are occasionally born of a size and weight greatly exceeding the average. Thus a nine-months child has been born weighing eighteen pounds and measuring thirty-two inches, whereas the usual weight is from six to seven pounds and the length eighteen inches. In such an exceptional case there is reason to believe that had the child come into the world at the seventh month, it would then have appeared to the accoucheur to have reached the full term. As it is impossible to say when such an exception is likely to occur, it follows that, in any case in which this question arises, a witness will be bound to admit that a seven-months child may be born of the average size and weight of a nine-months child, or to give some valid reason for the fact that great variations in size and weight may occur at the ninth but not at the seventh month of gestation. If the child is a male, and the testicles are found in the scrotum, there is every reason to believe that it has passed the seventh and even the eighth month of uterine life. (See "Infanticide.") The differences of opinion among obstetric experts in reference to this question admit of an explanation. All will agree that, as a general rule, a seven-months child might be distinguished from a nine-months child, unless the latter was a twin ; but at the same time it must be admitted that if variations in development take place at the full term, there is nothing to prevent such variations from occurring at the seventh and eighth months of gestation. Hicks has seen a child born seven months after marriage as large as at the full term; but this child might really have been born at the full term. In order to determine this point by unexceptional facts, it would be necessary to collect a series of cases of impregnation from one intercourse in which the children were born seven months after such intercourse, and were proved to have had the average size and weight of mature children.

When the facts are such, that to be the offspring of the husband it must be a *six-months* child, and it is born *mature*, there can be no reasonable ground to doubt its illegitimacy. This question was raised in the Exchequer Sitting (January, 1847), on a motion for a new trial in the case of *Eager* v. *Greenwood*. The action was one for seduction ; and the principal witness in the case, on being cross-examined, stated that she was first connected with the defendant a few days before Christmas, 1845, and that the birth of the child took place in the June following—*i.e.*, in about six calendar months. Under these circumstances, as the child appeared to have been full-grown, the Chief Baron, assuming the statement of the dates to be correct, intimated it to be his opinion that the action could not be maintained, as the foundation of it was the loss of service, arising from the defendant's intercourse with the daughter, and her subsequent confinement, and that it was impossible that he could have been the father of the child in question. The jury found for the defendant. A rule for a new trial was granted, chiefly on the ground that the woman had, from confusion in giving her testimony, made a mistake in the period. A similar question may arise in cases of divorce, and the fact be received as proof of the act of adultery.

In the case of Maclean (House of Lords, March, 1851), it was proved that the earliest intercourse which could have been had with the husband was on December 22nd, 1847 ; while, according to the medical evidence, the child was born on July 6th, 1848, thus giving a gestation of only 197 days, or twenty-eight weeks and one day, assuming the husband to have been the father; but the child was a full-grown nine-months child. This fact was received as proof of adultery on the part of the wife.

In Hawkins's case (May, 1852), it was proved that there had been no access of the husband, owing to his absence, between May 16th, 1850, and March 23rd, 1851. A full-grown and *mature* child was born on June 2nd, 1851 : hence, to have been the child of the husband, gestation must have been extended to a year and sixteen days, or reduced to a period of only seventy-one days. This was taken as clear proof of adultery on the part of the wife. It is to be remarked of this case that the husband had slept with his wife after his return, even up to five minutes of the time of her delivery, without suspecting his wife's pregnancy ; and her female attendant, who had been in the habit of seeing her daily, did not observe any alteration in her personal appearance. This created a little difficulty in the case ; but it merely serves to show, either that a visible prominence of the abdomen is by no means a constant accompaniment of the pregnant state, or that it may be very easily concealed.

How Long can Gestation be Prolonged.

We are here treading upon more important ground even than in shortened gestation, and also upon, in some senses, firmer ground, for we have not to trouble ourselves about such delicate and disputed points as to what stage of development the child has reached.

Of course, to make the ground absolutely sure, there must be unimpeachable evidence of the last possible chance of insemination. A rigid comparison can only be instituted between periods of gestation thus ascertained; unfortunately, in most or many of the cases that follow, this method of estimation has not been followed, and allowance must be made ; for all that, the cases are valuable and must be treated in full. Those which are the result of one coitus are naturally the most reliable.

That gestation may be retarded or protracted beyond the fortieth week is now, probably, not disputed by any obstetric writer of reputation. Some accoucheurs have denied it, because they have not met with such cases ; but the medico-legal relations of such questions do not depend on the solitary experience of practitioners. It is only by the accumulation of well-ascertained facts from all authentic sources that medical knowledge can be made available for the purposes of the law ; otherwise, owing to the mere accident of a witness not having met with any exceptional instance, a court may be entirely misled in its judgment by trusting to his opinion. It is the more important to attend to this, because most of the cases involving questions either of contested legitimacy, or the chastity of females, turn upon protracted rather than upon premature delivery.

Protracted cases of gestation are always open to the objection, either that the menstrual function may have been suspended from some hidden morbid cause, one or two months before the actual date of conception, or that there may have been some error in the calculation by which the period has been determined. If, however, the objection be admitted under these circumstances, it would be only equally just to admit that in any given case the ordinary and so-called fixed period, calculated from the cessation of menstruation, is based on a fallacy. The menstrual function may have accidentally ceased, or continued for several intervals after conception, and thus a corresponding change should be made in fixing the ordinary period of gestation. This view of the question implies that no reliance can be placed on the date of the cessation of the menses as evidence of the actual duration of pregnancy, whether natural, premature, or protracted. Hicks met with a case in which the pregnancy of a woman appeared to be protracted to between twelve and thirteen months. There was every reason to believe that this woman had become pregnant during the absence of the menses, their suspension having taken place some time before intercourse; and this, no doubt, is the explanation of a large number of cases of alleged protracted gestation.

The cessation of the menstrual discharge must be either taken or rejected altogether as evidence; if taken, we have no right, in alleged protracted cases, to refer the suppression to disease, for the sake of shortening the period, when in ordinary cases we do not refer its continuance to disease, because this would tend to lengthen it; if rejected, it would be in the highest degree unjust not to give to a claimant the beneficial presumption of his having been born legitimate, when the cases adduced in evidence against his claim are actually based upon a precisely similar mode of calculation.

It is difficult to admit that all the protracted cases recorded by different observers have depended upon mistakes being made in the calculation of the period, since this calculation is based upon the same principles as those adopted in cases of ordinary pregnancy. Hence, if there is a mistake in the one case, there would be in the other; if an error in the exception, there would be an error in the rule. Either the average term of pregnancy is wrongly calculated by most accoucheurs at the thirty-eighth or fortieth week, or it is rightly calculated to extend occasionally to the forty-fourth or, admitting these protracted cases, to the *forty-sixth* week. But, even setting aside the obvious answer to an objection of this nature, some of the cases observed were instances of impregnation from a single intercourse; and, making due allowance for the interval for conception, the general inference would not be affected, and no fallacy would have arisen in such cases of protraction from mistakes dependent on the cessation of menstruation.

Some instructive papers on this subject were published by Reid (*Lancet*, 1853, 2, pp. 205 and 235). The conclusions at which he arrived are decidedly adverse to the views of Murphy regarding the great duration of pregnancy. He states that an accidental arrest of the menstrual discharge may take place for three, four, or many successive periods, while impregnation may have occurred at any time during this suspension. Under these circumstances, a calculation based on the date of the suspension of the discharge would, of course, be erroneous; and "the number of days which elapse after the last menstrual appearance is not, therefore, *any proof* of the real extent of gestation in otherwise doubtful cases." In one case which he reports, labour occurred 294 days after menstruation, but 278 days after intercourse; in a second, 287 days after menstruation, but 276 days after intercourse ; in a third, 281 days after menstruation, but 277 days after intercourse ; and in a fourth, 294 days after menstruation, but 279 only from the earliest possible time of conception (intercourse). It will be perceived that while the dates from intercourse varied slightly, those from menstruation varied considerably. In a case reported by Montgomery, the last menstruation was on October 18th. Impregnation (intercourse?) took place on November 10th, and parturition followed on August 17th. The interval between intercourse and parturition was thus 280 days, and between the last menstruation and parturition it was about three weeks more—namely, 303 days.

Reid's conclusions, derived from numerous facts and cases, represent the views of an experienced observer on this much-disputed question. They are—" 1. The duration of pregnancy is not altogether a fixed period : it varies somewhat in the human female, as it does in the lower orders of animals. 2. This deviation, however, is not to any great extent: the only *certain* data of calculation are those dependent on the *known time of conception* (of *intercourse?*). 3. The *average* duration of the pregnant state, when calculated from this event, is about 275 days, or it may have a range of from 270 to 280 days. 4. There is no full or satisfactory evidence of gestation having been prolonged beyond 293 days. 5. The French Code, which allows 300 days, may be regarded as liberal. 6. The menstrual period must generally serve as our guide in default of some exact knowledge: it is, however, often fallacious, and is only a means of approximation to the probable time of parturition. 7. The fortieth week after the last appearance of the menses is the most likely period, and the forty-first week the next."

Duncan (*Edin. Month. Jour.*, 1854, vol. 9, p. 230) draws the following conclusions regarding the duration of pregnancy :—1. That the interval between conception and parturition (the real duration of pregnancy) has not been exactly ascertained in any case. 2. That the average interval between insemination (intercourse) and parturition (commonly called the duration of pregnancy) is from 275 to 278 days. 3. That the average intervals between the end of menstruation and parturition have no standard length, but vary within certain limits. 4. That while absolute proof of the prolongation of real pregnancy beyond its usual limits is still deficient, there is evidence to establish the probability that it may be protracted beyond such limits to the extent of three or even four weeks.

It will be perceived from the conclusions drawn by Reid, that he admits a variation of 23 days, *i.e.*, from 270 days (the shortest period) to 293 days, the longest known to himself from a single intercourse. There appears to be no valid reason why the variation should not be even greater than that which is here assigned, and why the duration of pregnancy might not extend occasionally to 296 and even to 301 days. It is merely a question of individual experience. An accoucheur who admitted a variation of 23 days, and who had known gestation to be protracted to the 293rd day after intercourse, would hesitate to pronounce a child illegitimate merely because it had been born on the 296th or the 300th day after the possible access of the husband. Duncan places his average from one set of cases at 275 days, and from another set at 278 days ; but he allows that gestation may be extended four weeks beyond these limits. Taking the shortest period and adding to it 28 days, this would make a possible extension of gestation to 303 days, or forty-three weeks and two days. **There is no doubt a limit to gestation, but it is not in our power to fix it**; hence we find obstetric writers of repute adopting periods which have no point of agreement among themselves. Some stop short at 280 days; others, like Reid, fix the maximum yet known at 293 days. Murphy allows from his experience at least 324 days; and Meigs considers that gestation may be continued to twelve months or 365 days ("Obstet. the Science and the Art," 1849, p. 194). The fact is, the term has not yet been fixed even approximately by medical science: hence, in a disputed case, other circumstances must be looked to in order to lead a court of law to a safe decision. It is at present hopeless to reconcile the conflicting medical opinions which exist on the subject of duration of pregnancy in the human female. There is, indeed, only one point on which all modern observers agree, namely, that the period cannot be limited to a certain number of days, but that it is liable to variation according to circumstances but little understood.

It has been already observed that the date of intercourse does not furnish us with the date of conception, and according to some authorities all evidence connected with the function of menstruation is untrustworthy. In spite of these objections, the menstrual period must generally serve as a guide in default of more certain criteria. It is, however, a curious fact that the date of the cessation of the menses is taken by some physicians as a guide (in married life with constant intercourse), so long as gestation does not extend beyond 280 days; while, supposing it to extend to 300 days, they will assume that some other cause than pregnancy must have led to an earlier suppression, and thus to an error in the calculation. There may be no more evidence of suppression from a morbid cause in the one case than in the other, and the period of 280 days may therefore be as much based on error as the period of 300 days. It is strange that writers, who adopt this mode of making facts square with a foregone conclusion, do not perceive that they must, in fairness, either reject altogether the evidence derived from the cessation of the menses, or admit it adversely to their own views, in cases in which the facts connected with the cessation have been as carefully observed and recorded by others as by themselves.

Enge ("Inaug. Dissert.," Leipzig, 1903) follows up the researches of von Winckel, and has made use of the register of the Leipzig Maternity for the seventeen years preceding the issue of this thesis. In 175,333 births there were 821 children over 4 kilog. ($9\frac{7}{10}$ lb.) in weight and over 50 cm. ($19\frac{1}{2}$ in.) in length. The ratio of female to male infants was 100 : 110; 264 mothers had correctly reckoned term from the first day of the last period, 61 from the last coitus, and 81 from both factors. In 40 of these accurately reckoned cases the period lasted over 302 days, the maximum being 321. The average length of the children in these cases was 53·5 cm. (20 in.).

Such is a fair presentation of the arguments as based upon the opinions of those who were best qualified to judge. We may now give some reported cases and evidence which is strong enough in medical practice, and, *provided that other evidence is satisfactory*, one would think should be strong enough in law; but in *Robinson* v. *Robinson and Asplin* (a case communicated to Dr. Stevenson) the judge refused to accept cases recorded in journals, etc., as evidence. It is true, on the one hand, that the woman's statements in such (journal) cases are not sworn; but, on the other hand, they are usually given without any cause or motive for *malâ fides*.

In works on midwifery will be found authentic reports of cases in which gestation continued to the forty-first, forty-second, forty-third, and even to the forty-fourth week. Murphy regards 301 days, or forty-three weeks, as the average limit of gestation ("Obstet. Rep.," p. 4). Lee met with a case in which he had no doubt that the pregnancy lasted 286 days: the labour did not take place until forty-one weeks after the departure of the husband of the lady for the West Indies (*Med. Gaz.*, vol. 31, p. 917). William Hunter met with two instances in which gestation was protracted until the forty-second week. Montgomery met with a case in which delivery did not ensue until between the forty-second and forty-fourth weeks (*Med. Gaz.*, vol. 19, p. 646). Merriman published a Table on the subject of protracted gestation, on which the most experienced accoucheurs have been in the habit of relying. Of 114 pregnancies, calculated by him from the last day at which the women menstruated, and in which the children appeared to be mature, the following were the periods:—

In the 37th week	3	In the 41st week	22
,, 38th ,, ...	13	,, 42nd ,, ...	15
,, 39th ,, ...	14	,, 43rd ,, ...	10
,, 40th ,, ...	33	,, 44th ,, ...	4

In another well-marked case, birth occurred forty-four weeks precisely after the cessation of the menses.

From these results Merriman considered that in the greater number of women gestation is completed in the fortieth week from the cessation of the menses, and next to this period in the forty-first. In the evidence given by him before the House of Lords in 1825, the case of longest protraction on which he was able to rely was that of a married woman, who was in the habit of calculating from the last day on which her monthly period ceased. The lady was delivered 309 days, or forty-four weeks and one day, from the time at which she supposed that she had conceived. In another case the period was 303 days, or forty-three weeks and two days from the termination of the last monthly period.

A healthy woman, æt. 30, had borne three children, the youngest being four years old. She had menstruated regularly up to the third week in June: the menses then stopped without any apparent cause. Her delivery took place 323 days after their last appearance. Allowing that impregnation occurred at the intermenstrual period, this would make the gestation 309 days; or assuming that impregnation did not occur until twenty-eight days from the date of the last menstruation, this would make the period 295 days, or forty-two weeks and one day. Murphy furnished some facts in reference to this subject. Out of 182 cases, in which special inquiries were made of the women, the deliveries took place from the date of the last appearance of the menses at the following periods in weeks. The details are given in his "Rep. of the Obstet. Practice of Univ. Coll. Hosp. for 1844":—

In the 33rd week	5	In the 40th week	25
,, 34th ,, ...	3	,, 41st ,, ...	32
,, 36th ,, ...	6	,, 42nd ,, ...	25
,, 37th ,, ...	11	,, 43rd ,, ...	19
,, 38th ,, ...	12	,, 44th ,, ...	9
,, 39th ,, (9 months) . .	24	,, 45th ,, ...	11

The most protracted of the cases in his Table was No. 182, where the period of gestation was 329 days, or, deducting twenty-eight days (the ascertained menstrual interval), 301 days, or forty-three weeks—*i.e.*, three weeks beyond the usual period. Out of thirty cases of single or well-defined coitus collected by Ahlfeld, gestation varied from 233 days to one case of 313 days (*Amer. Jour. Med. Sc.*, October, 1870, p. 566).

The following is from *B. M. J.*, September 14th, 1899, p. 598, reported by Dr. F. R. Humphreys:—

"Mrs. F., multipara, returned from the seaside to her husband on September 21st. She had had severe flooding while away. In the first week of October she menstruated, the flow being very small in amount. From the end of this week, that is, from October 6th to August 16th, when the child was born, is 314 days. About the middle of June genuine labour pains appear to have come on, and, after continuing for some considerable period, to have passed away. At the birth (head presentation, fourth position) there were no perceptible labour pains; the membranes had ruptured before my arrival. The head was fixed at the brim, and had to be delivered with forceps. The forehead was completely moulded away, the child dying a few days later from meningitis. This was the second male child the mother had lost similarly; all the female children had survived. The mother is extremely rickety, and no doubt the pelvis had suffered along with the other bones."

This is from the *B. M. J.*, December 27th, 1892, p. 1950, reported by Dr. James Oliver. It is interesting in that disease did not shorten gestation.

"Mrs. D., aged 36, consulted me on February 19th, 1902, on account of general abdominal discomfort. She then stated that she had missed being unwell in January, and that the December period, which occurred about the correct date (20th), was less prolonged (continuing for two days only) and more scanty than usual. She was anxious to know whether she was pregnant, and, if so, whether she should reckon from December 20th or whether she might have conceived before the December menstruation.

"I found the hypogastrium occupied centrally by a swelling which extended from the pelvis to three inches above the pubes. I drew off the urine by catheter, but this did not cause any alteration in the hypogastric swelling. The cervix was softish, and the hypogastric swelling was the enlarged uterus with a fibroid of about the size of a small tangerine orange in its right half. The breasts were in appearance characteristic of pregnancy.

"After taking the fibroid into consideration I informed her she was about two months advanced in pregnancy, and that the confinement would in the ordinary course take place about September 24th. Towards the end of April the movements were first felt.

"I have just learned that this patient was confined on October 21st—that is, on the 305th day after the cessation of the last menstruation. The child, a female, is living.

"In this case there can be no doubt about the facts, as they were recorded by me as early as February 19th."

The following case, reported by Dr. John Phillips, of Southsea, in the *Lancet*, January 13th, 1900, p. 94, suffers from the criticism that more than one act may have been performed.

My patient was a primipara and unmarried. Intercourse was declared to have taken place on one occasion only—September 6th, 1898—the girl's age at that time being only sixteen years and four months. Her menstrual periods had occurred at regular intervals, and they usually lasted about a week. Her last period had occurred in August, 1898, and had entirely ceased by the 24th of that month, this being the first day on which she considered herself "well," and it was from this date that I calculated the probable duration of pregnancy. In consequence of her missing her next two periods in September and October, her aunt, with whom she lived, took her on October 24th to a medical man in London, to whom the girl confessed, when questioned, that she had had intercourse, and he expressed the opinion that she was most probably pregnant. This proved to be the case, and in April of the present year she came under my observation, and I was asked to attend her in her confinement, which I calculated would take place somewhere about May 29th, this being the usual average period of 278 days from the cessation of her last menstrual period (August 24th, 1898), from which I reckoned. Instead, however, of the confinement occurring at the expected time, she not only went through the whole of June without a single pain, but labour did not set in until July 13th, on which date the pains began at 6 p.m.—323 *days after the cessation of* *her last period and* 310 *days after the date of coitus*, the child being born on the following day at 4.30 p.m. There is not the slightest doubt that no menstrual period occurred subsequently to that in August, as, in addition to the girl's own statement, her aunt, who always looked after her linen and who consequently always knew when her niece was unwell, declares that there "was not a stain" subsequently to the August period. During the entire pregnancy the girl had excellent health, and there were no pains of any description prior to the onset of labour, which was perfectly normal and the presentation the usual cephalic one. Unfortunately at the time I had no opportunity of having the child (a female) weighed, as it was sent away to be nursed almost immediately after its birth (within three hours), but, although well proportioned and of good size, it did not seem at all unusually large.

Power reported in his work on "Human Pregnancy" a case in which gestation is said to have extended to 325 days.

The wife of a labourer who went to America on May 6th, 1864, was confined on March 24th, 1865—*i.e.*, 322 days after the departure of her husband. The woman had already borne four or five children, and her character was uniformly good. The infant was mature and well formed, the mother a fragile, delicate person, and was suckling a child when her husband left her. Was this the child of the husband? On being informed of the facts, the man said he was willing to give his wife the benefit of any reasonable doubt, but otherwise he would not return home, or acknowledge the child as his. As this case did not exclude a possible act of adultery, the opinion given was adverse to the claim of legitimacy. When the cases involve such unusually long periods of gestation, we must look with great suspicion on all the alleged facts. We must take nothing for granted. It is far more probable that this woman had had intercourse with some man about June 20th, 1864, than that this child was begotten by the husband in the month of May previously. According to the observations of Murphy and others the time is not impossible, but unless the facts absolutely exclude subsequent intercourse, the case proves nothing as to protracted gestation. A healthy woman, æt. 36, stated that she expected her confinement to take place in September, 1856. The menses appeared for the last time in December, 1855, and she quickened in the beginning of April, 1856. About the middle of September (*i.e.*, on the 283rd day, dating from the last menstruation), Chattaway was summoned to attend her, and he found her labouring under severe false pains; there was also a discharge of mucus tinged with blood. The case went on until November 19th, 1856, when the patient was delivered of a female child of the average size. It would thus appear, according to the ordinary mode of calculation, that, deducting twenty-eight days from the last appearance of the menses, gestation was protracted in this instance to 330 days, or forty-seven weeks and one day. Carey has reported (*Lancet*, 1873, 1, p. 293) the case of a primipara, æt. 32, whose gestation extended, as he believed, to 350 days. This was, however, a matter of inference from circumstances which might admit of another interpretation. In addition to these, Schuster (Maschka, "Leg. Med.," vol. 3, p. 258) mentions the case of his own wife, who went 325 days from the end of menstruation.

In the *Lancet*, 2, 1904, p. 1379, a case of 324 days' duration is recorded.

These cases, assuming the facts to have been correctly observed and reported, meet the objections taken to the medical evidence in the Gardner Peerage case. All women may not have such unusually protracted pregnancies—indeed, it is well ascertained that no two women are alike in this respect, and that two successive pregnancies in the same woman are rarely alike in duration. Then, again, some medical men may not have met with protracted cases; but the fact being clearly ascertained must be accepted, unless we doubt the credibility of reporters, well qualified to observe and having no conceivable motive to misrepresent the medical facts which came before them. The advocates of a fixed and a limitable period differ from each other by a space of at least ten or twelve days, and each must either take his own experience for the final decision of this question, or it must be allowed that men of equal powers of observation and experience with themselves have met with cases which have gone beyond their own fluctuating limits.

The question of how long a woman may carry an extra-uterine gestation that has mummified or become a lithopædion has no practical bearing on our present subject, with just the possible exception that an extra- and an intra-uterine pregnancy occasionally have been known to occur simultaneously. The former might start a period of pregnancy, and the latter keep it up so as to apparently prolong gestation.

Analogy with other mammalia is admittedly a dangerous argument, but there is this to be said about the following Table, that the actual facts themselves in regard to coitus are beyond suspicion. A great variation in duration of gestation in the particular animals is therefore conclusively demonstrated.

Animal.	Average Period.	Days between Extremes.	Percentage.
Horses .	335	129	40
Cows .	285	81	28
Sheep .	153	11	7
Rabbits .	30	8	26

If we take the average of women as 280 days and allow them 80 days between extremes, this would mean 240 to 320 days as the limits calculated on the above Table.

SUB-SECTION D.—DELIVERY.

Delivery is a subject which much more frequently requires medico-legal intervention than pregnancy. In undertaking the investigation, we ought, if possible, to ascertain, either from the woman herself, or from those around her, whether there was reason to suspect that she had been pregnant. If we can acquire any knowledge on this point, it will materially facilitate the inquiry; but this is not always possible. In the cases in which the law asks for proofs of delivery it often happens that pregnancy has been so concealed that few who saw the woman suspected her condition; then again, as the admission of her delivery may be the strongest proof of her criminality, she may perhaps resolutely deny it; a medical practitioner has no right to extort this admission from her. From this it will be seen that a medical witness must often be prepared to prove the fact of delivery against a woman who is criminally charged.

The uterus of a woman that has become pregnant can only be emptied in one of two ways, either naturally or artificially. The former constitutes delivery which may be premature or at full term, the latter constitutes what the law defines as abortion [in medicine it is convenient for purposes of description to distinguish between an abortion in the first three months, a miscarriage in the second three months, and a premature delivery in the third three months; the law makes no such distinction], and not only so, but makes it a criminal act, no matter by whom, nor by what means, nor for what purpose effected (*vide* sub-section "Abortion").

Cases not infrequently arise both in civil and criminal law in which this question of delivery, recent or remote, natural or artificial, becomes the all-important question to be decided by the medical jurist. We shall consider it in the following order:—

Legal reasons for demanding proof of delivery.
Signs of recent delivery in the living.
,, ,, ,, ,, dead.
,, remote ,, ,, living.
,, ,, ,, ,, dead.

Legal Reasons for demanding Proof of Delivery.

These may be enumerated as follows:—

(*a*) The question may arise in **legitimacy** or **supposititious children** (*vide* sub-section F.).

(*b*) In **abortion** or **infanticide** (*vide* sub-sections H. and J.).

(*c*) In **libel** actions or actions for **defamation of character**. These cases as a group do not belong to medical jurisprudence, and are therefore not further considered, except the following illustrative case:

In *Kitson* v. *Playfair*, before Mr. Justice Hawkins in March, 1896, Dr. Playfair judged that something removed from the uterus of Mrs. Kitson was the product of conception.

In a correspondence on the subject Dr. Playfair informed Mrs. Kitson of the opinion he had formed, and intimated to her that he could only keep intact the seal of professional secrecy on condition that she left London and broke off social intercourse with his immediate family circle, or that she could show that she had seen her husband within a period which would remove the grounds of the charge of unchastity. From first to last, though she had to face as terrible a situation as it is possible to imagine a wife and mother to be placed in, Mrs. Kitson persisted in her innocence. Dr. Playfair not finding his suggested terms of compromise accepted, informed his wife and also Mrs. Kitson's brother-in-law of the facts and the deduction he had drawn from them. This was the slander complained of and on which issue was joined in the High Court.

No plea of justification was put on the record, and consequently the presiding judge would not allow charges aspersing Mrs. Kitson's character to be made in court. She obtained a verdict with very heavy damages.

(*d*) For purposes of rebutting **extortion** or avoiding an attempted **compulsory marriage**.

(*e*) **In concealment of birth**.

In all of these the establishment of the *fact* of delivery may become of the very highest degree of importance for the purposes of justice, as is duly noted in the respective sub-sections, but it is only in the last case that the criminal law has a special clause referring to delivery *per se*.

Concealment of Birth.—24 & 25 Vict. c. 100, s. 60, runs as follows:—

If any woman shall be delivered of a child, every person who shall by any secret disposition of the dead body of the said child, whether such child died before, at, or after its birth, endeavour to conceal the birth thereof, shall be guilty of a misdemeanour, and being convicted thereof, shall be liable, at the discretion of the court, to be imprisoned for any term not exceeding two years, with or without hard labour; provided that, if any person tried for the murder of any child shall be acquitted thereof, it shall be lawful for the jury by whose verdict such person shall be acquitted to find, in case it shall so appear in evidence, that the child had recently been born, and that such person did, by some secret disposition of the dead body of such child, endeavour to conceal the birth thereof, and thereupon the court may pass such sentence as if such person had been convicted upon an indictment for the concealment of the birth.

This concealment of birth is an offence of which women charged with child-murder have been hitherto commonly convicted in England. There is great reluctance in English juries to convict women, under such circumstances, of the capital offence of murder, and consequently they very frequently take advantage of the proviso to the effect that any person tried for the murder of any child, and acquitted thereof, may be found guilty of concealment of birth, if it shall appear in evidence that the child had recently been born, and that such person did by some *secret disposition of the dead body* endeavour to conceal the birth.

The medical evidence on trials for this misdemeanour is exclusively derived from an examination of the mother; and thus, much will depend upon the time at which this is made (*vide infra*). With respect to the child, its body need not even be produced, provided there be satisfactory evidence of its death: the body may have been secretly buried or burnt, and in the latter case it may be necessary to examine the ashes (see vol. 1, pp. 214 *et seq.*).

According to the statute the child must be *dead*—the concealment of the birth of a living child not being in England any offence, unless it should happen to die before its birth was made known. In the case of *R.* v. *Woodman* (Kingston Lent Ass., 1845), the woman was acquitted because the child was living when concealed. Chitty says that, in order to constitute the offence, the child must have advanced to the end of the seventh month ("Med. Jur.," p. 412); but it is to be presumed that the concealment of the birth of a dead child at the sixth or seventh month would be as much an infringement of the statute as if it were more advanced. The concealment of the aborted, but undeveloped, ovum or embryo of a monster—*i.e.* a child without human shape, a mole or other morbid growth—would not probably be considered a contravention of the statute. There has been no judicial decision on this point. Lane communicated (*Med. Times*, August, 1845) a case in which a charge of concealed birth was dismissed by the magistrates, because the concealment referred to a child born at the eighth month, *in its membranes*. The woman stated that she did not consider it to be a child. If this decision be correct, the main object of the statute (*i.e.*, to prevent secret delivery, so often leading to murder) may be effectually evaded. The case, being entirely new, should have been sent for trial, and the decision left to the proper interpreters of the law: a magisterial decision can furnish no sufficient precedent on a question of this kind. This woman must have been delivered of a child, fœtus or embryo, or of course there would have been no excuse for the charge. That a child may be thus born and removed from the membranes alive is a fact established by experience.

It will be perceived that it is not material here, as it is in a case of alleged infanticide, to prove *when* the child died—whether before, during, or after its birth; and thus those subtleties and technicalities which are met with in cases of child-murder are avoided.

In regard to proof of concealment and what constitutes it these are essentially legal points: various interpretations have been put upon the terms "concealment" or "secret disposition" of the body. This part of the evidence does not affect a medical witness, unless he himself has found the dead body or was present when it was found. It will rest with the judge to determine whether the body has been so disposed of as to constitute legally a misdemeanour (*R.* v. *Clarke*, Chelmsford Sum. Ass., 1864). The law is especially lenient under such circumstances. A very strict interpretation appears to be put upon this term concealment. There must be a "secret disposition" of the dead body. In a case tried before the Recorder of London (*R.* v. *Honeycombe*, C. C. C., August, 1871), a woman indicted under the statute was acquitted because the evidence showed that the body of the infant was found on a rising ground in a field which was visible from a public highway. This was held not to be concealment. In another case, a girl who was far advanced in pregnancy went into a recess by the side of the road, and was there delivered. The body of a child was afterwards found there by a boy who was passing. This case was reserved as to whether this was such a secret disposition of the body as to constitute the legal offence of concealment of birth.

In 1909 a case came to the knowledge of the editor in which the body being placed in a box under the bed, this was not deemed concealment because the box was not locked.

In a case under the Scotch statute in reference to the concealment of pregnancy, this question arose, viz.—"Whether the charge was excluded if the woman, an unmarried female, proved that she had intimated that she was with child to the father, but denied the pregnancy to every one else? That the object of the statute was defeated in such a case, and yet that the main fact on which the statutory offence is founded was proved, could not be doubted. Concealment, and not calling and making use of assistance in the birth, constitute the offence. The Court of Justiciary was nearly equally divided. The majority went on the bare terms of the statute: the minority held that concealment was here a general term to denote the denial to all near and around the woman, and from whom assistance might be obtained, and was coupled with not calling for assistance in the birth. As a letter written to Australia, if the father had gone there, could not be taken to exclude the statutory offence, and as the woman concealed her pregnancy, and had obtained no assistance in the birth, an expression which shows what the character of the concealment referred to is, the communication of the fact of pregnancy to the father of an illegitimate child (often more anxious to get rid of the child than the mother) really could not lead to its preservation, and left the concealment to which the statute referred equally complete. But the point was not actually decided, as it was thought that the terms of the special verdict did not raise the question, but, by an accidental form of expression, excluded it."

It is not usual to find a married woman charged with this offence, but a man and his wife were convicted of concealing the birth of a child (*R.* v. *Curtis and wife*, Lincoln Lent Ass., 1872).

The woman was delivered of a still-born child early in the morning, and the husband buried the body in his garden, where it was afterwards found. Before the birth of the child the woman denied that she was pregnant, and after her delivery declared that she had not been aware of her pregnancy. The difficulty in the case was that no reasonable motive could be assigned for a husband and wife concealing the body of a dead child.

SIGNS OF RECENT DELIVERY IN THE LIVING.

These may be divided into the general and the local, and the two factors which entirely govern them are (1) the time that has elapsed since delivery; (2) the stage of growth and development which the expelled contents of the uterus had reached.

We may enumerate those that can possibly occur, with a few comments on them individually, and then sum up the evidence in general terms.

1. **Languid Look with Pulse and Temperature Slightly Increased.**—These are common in most slight illnesses, and are found with menstruation often enough. They disappear normally after two or three days from delivery.

2. **Peculiar Odour.**—Easily recognisable in the lying-in room of the poorer classes, and on turning down the bed clothes, in any woman. It is chiefly due to the vaginal discharge; it is perceived in many cases

of menstruation owning the same cause. Disappears in a week or ten days with the discharge.

3. **Breast Changes.**—These are full with a knotty feeling, and milk may be expressed; they are usually tender, and the areolæ are darkened. This condition of the breast is strong evidence, and lasts much longer than the other points. The pigmentation rarely *entirely* disappears, and hence is of some little value in estimating remote delivery. The drying up of the milk is extremely variable in its occurrence, and occasionally none appears at all, so that from the presence of milk it is impossible to make any definite deductions as to *when* delivery took place. For milk in virgins' breasts *vide* p. 29.

4. **Abdomen Flaccid.**—Only corroborative of other details, abdomens are flaccid from hundreds of causes.

5. **Lineæ Albicantes Easily Seen.**—These, whether recent or old, are simply evidence of previous prolonged distention of the abdominal walls—I might even say of the skin, for they are often enough seen in either sex when subcutaneous fat has been or is excessive; they are no proof that pregnancy was the cause of this distension, but, failing other possible causes (now or in the past), they are suggestive of past pregnancy.

6. **Uterus Enlarged and Easily Felt.**—This, again, may have been caused by pregnancy, and may be suggestive, but the other causes are very numerous, as is well known in gynæcology.

7. **Perineum Lax and perhaps Torn.**—If the fourchette be still intact, one may swear that the woman has not had a full-time child, and probably not one that was capable of living: if it is ruptured, one may swear that some large object has passed, or some accident happened to the vulva. A similar line of reasoning, though not quite so rigidly applied, may be used of the perineum—*i.e.*, the perineum does not rupture in parturition so easily as does the fourchette: the greater the tear the more probably due to a full-time child; *per contra*, an intact perineum is no proof against a full-time child. The age of the tear in either case may be of value in fixing the date of delivery.

8. **Vagina Lax and possibly Lacerated.**—This condition, if well marked, is valuable corroborative evidence, but (at any rate in multiparæ) the natural condition is too variable for definite conclusions.

9. **Os Uteri Flabby, Patulous, and perhaps Torn.**—This condition is strong evidence, for it is never found in a nulliparous uterus, except in the rare cases in which a polypus has forced open the uterus. This laxity, and the state of any lacerations of the cervix, are valuable indications as to the time of delivery. Blood oozing from the cervix is not a sign of much value, unless there is clear evidence that the woman has not suffered from a vaginal discharge. Endocervicitis is a frequent cause of such oozing.

10. **The Lochia.**—These constitute very strong evidence in the very early stages (first three to four days). They usually cease to be bloody about the third day, and after then so much resemble other vaginal discharges as to be of little value as indication of delivery.

As a general criticism on the above, it must be observed that no one of them alone is absolutely conclusive, but the law of multiple evidence (vol. 1, p. 122) comes here also to our assistance, and the presence of many of them in combination gives very strong proof. They will also be indistinct in proportion to the immaturity of the ovum, and in a case of delivery within two or even three months of conception, there is very little chance indeed—none of legal value—of distinguishing a miscarriage from menstruation, at any rate after twenty-four hours have passed, unless indeed the ovum, fœtus, or any of its membranes be found, then the presumption of abortion will be strongly supported; but women who designedly conceal their condition will commonly take effectual means to prevent the examiner from obtaining evidence of this kind. For the size of ova and fœtuses of various ages *vide* vol. 1, pp. 196 *et seq.*

If any material delay has taken place before the examination is made, even the ambiguous signs which have been mentioned will have considerably diminished in definition: so that after a period, which is short in proportion to the earliness after conception of the expulsion, no traces whatever will be discovered.

Montgomery met with a case in which abortion took place, with a considerable loss of blood, at the close of the second month. Twenty-four hours afterwards, the mouth and neck of the uterus were almost completely restored to their natural state. The vaginal and external parts were hardly, if at all, dilated, and very little relaxed; the breasts exhibited imperfectly the appearances which accompany pregnancy, the ordinary sympathetic symptoms of which had been almost entirely absent ("Cyc. Pr. Med." 504; also Devergie, vol. 1, p. 683).

In such a case as this—and for such cases a medical jurist must be prepared—scarcely a presumption could have been entertained of the fact of delivery. After twenty-four or thirty-six hours, in the greater number of these early cases, we may expect to find, from a personal examination of the woman, no proofs whatever of abortion.

In the later stages of pregnancy, the sum total of a combination of the signs is usually more conclusive, and the signs last longer, but even here "delay is dangerous."

In some strong and vigorous women the body resumes its natural state within a few days, and the traces of parturition may have wholly disappeared, or have become so ambiguous as to furnish no satisfactory evidence. In others, again, proofs of delivery will be obtainable for a fortnight or three weeks afterwards. In most cases, however, it is difficult, if not impossible, to say, after the lapse of *eight or ten days*, that delivery has certainly taken place, the signs having commonly by that time disappeared. In all cases the earlier the period at which an examination is made, the more satisfactory will be the evidence obtained. Montgomery once examined a woman, *five days* after delivery at the full time, and he was particularly struck with the degree to which the parts had been restored to their ordinary condition, especially the mouth and neck of the uterus, which hardly differed from their natural and unimpregnated form ("Cyc. Pr. Med., *loc. cit.*). This inquiry becomes of considerable importance in a case of alleged child-murder. When the body of a child is not found until after two or three weeks from the time of its birth, and the suspected woman denies that she has been delivered of a child, she will probably not deny her pregnancy, but may assert that she has had an abortion at an early period (see a case in Casper's *Vierteljahrsschr.*, October, 1863, p. 275). In cases of abortion at an early period the placenta is not always discharged at the time. A microscopical examination of the discharges might reveal structures of the placenta or chorion.

One cannot dismiss the subject without a warning to medical men to refrain from offering an opinion based only on general symptoms; a woman who wishes to keep her confinement secret will make the most extraordinary efforts to maintain her usual habits, and even without this inducement, the lower classes will often resume their occupations almost immediately.

The editor has known a woman to be found busy scrubbing the doorstep at 9 a.m., who had instrumental (forceps) delivery effected about the previous midnight. Tidy ("For. Med.," p. 128) saw a country woman doing heavy field-work the day after the birth of her ninth child, and quotes the following extraordinary case:—

Med. and Surg. Reporter, Philadelphia, June 13th, 1868.—(Dr. H. D. Ballard.) —Girl, æt. 18, delivered of a child, during the night. The delivery caused so little disturbance as not even to excite the suspicion of any member of the family. The girl came down to breakfast as though nothing had happened, walked to the school where she taught, a distance of half a mile, and when her duties were over, returned in the evening. The next day she walked twelve miles, and was married on the fifth day after her confinement.

We have incidentally mentioned above that parts of, or a whole, fœtus may be found which incontestably prove that some woman has given them birth. The same may be said of the so-called vesicular mole or vesicular degeneration of the chorion, which is complete proof of conception, for it arises in no other way. When, however, nothing but a mass resembling a blood-clot is found, this must not be assumed to be a product of conception without a thorough microscopical examination to show placental structure, for it is undeniable that clots may be extruded in simple menstruation. The reader is referred to works on obstetrics for the microscopical appearances of placenta. Suffice it to say here that distinct *cells* must be found differing from the white and red cells of the blood.

SIGNS OF RECENT DELIVERY IN THE DEAD.

Here again it is possible that all the local signs above enumerated may be present, though the general ones will have disappeared; the local ones will, too, more easily be detected, for the breasts may be cut open to look for milk, and may be examined under the microscope to show physiological activity. We may then enumerate 2 to 10 of the above signs and proceed.

11. **The Excised Uterus.**—This will show now more distinctly the laceration and bruising of the cervix. As regards its size this, of course, will vary with the period of gestation and the time after delivery at which death occurred; it is flabby for a day or two and gradually resumes its firmness. The inner surface is for a day or two still bloody, and ragged looking, especially at the site of the placenta. The orbicular direction of the fibres around the internal orifices of the Fallopian tubes is at this time very distinct. In about a

month the uterus will have become fully contracted; but the mouth rarely, if ever, closes so completely as in the virgin state. In a case in which a primipara, æt. 26, died from puerperal fever on the *sixth day* after delivery, the following appearances were met with in the uterus.

The internal surface was blackened and congested, especially in that part to which the placenta had been attached. There was here the appearance of suppurative action. The substance of the uterus was healthy; there was no pus in the sinuses. The os uteri showed considerable ecchymosis. The vagina was healthy; the iliac veins contained nothing but post-morten clot.

An ecchymosed condition of the neck of the womb is very commonly found as the result of even an easy labour, and therefore forms a good guide when present. This point must be borne in mind in reference to criminal abortion, inasmuch as the neck has the appearance as if violence had been employed. From the statement of appearances given above, it will be seen that there must be considerable difficulty in determining the period prior to death at which delivery took place. The difficulty is increased when a woman has been prematurely delivered, or when death has not taken place until some time after delivery. An opinion may be in some degree strengthened by searching for those signs which have been described as characteristic of delivery in the living. These, if present, will always furnish strong corroborative evidence, not only of the fact of delivery, but of the period at which it had probably occurred. The absolute size is not of much value, for involution proceeds at a different rate in different women. A very similar condition of congestion of the interior is found after menstruation. The reader is referred to works on obstetrics for further details of the appearances in the two conditions.

12. **The Placental Site.**—This is absolutely incontrovertible proof of a recent pregnancy; it is usually recognisable up to eight or nine weeks after delivery, and has been noticeable as long as twelve weeks after. It is of very dark colour, looking sloughy and gangrenous, and the sinuses are very evident in it.

13. **The Presence of a Corpus Luteum.**—During the last fifteen or twenty years of enormous increase in surgical activity in opening the abdomen to remove ovaries for diseased (and healthy) conditions, it is a natural fact that opportunities should have arisen, and have been taken full advantage of, for the purpose of settling two very vexed questions: (1) the relationship between ovulation (or the escape of an ovum from the ovary) and menstruation (*vide* "Duration of Pregnancy," pp. 14 and 40 *et seq.*); and (2) whether there is any difference between what used to be called true and false corpora lutea, or, in other words, between the corpus luteum of ovulation which resulted in conception, and that which did not so result. Exceptional cases of either class have been observed, but out of the mass of evidence, which is too voluminous and too irrelevant to quote here, the final decision has been arrived at and subscribed to by all obstetricians of repute, "that no reliance whatever can be placed upon the appearance of a corpus luteum in aiding a decision as to whether it was or was not the result of an ovulation resulting in conception." No object would be served therefore in quoting cases in which the characters of a corpus

luteum have formed matters of dispute. The practical conclusions are, first, that there may be pregnancy, and that notwithstanding a complete absence of a true corpus luteum; and, secondly, that bodies undistinguishable from true corpora lutea may be found where there has been no pregnancy, and (as I have myself noted—Ed.) in aged women, long past the period when pregnancy was probable. These investigations relative to pregnancy and delivery in the dead body are almost exclusively confined to cases of criminal abortion, where the contents of the uterus have been expelled at the sacrifice of the life of the woman. Death commonly ensues in these cases within two or three days after delivery, and then satisfactory proofs are obtainable by a post-mortem examination, but if the woman has survived three or four weeks, it may be as difficult to determine delivery in the dead as in the living subject, except for the placental site. This remark applies to delivery at the full period; for if the uterus has expelled its contents in the first months of pregnancy, the traces of this expulsion will have generally disappeared in the course of a few days.

Signs of Remote Delivery in the Living.

A question may arise whether it is in the power of a medical practitioner to determine the period at which delivery took place, *i.e.*, how long a time has elapsed. This becomes necessary when, in cases of concealed birth, abortion, or infanticide (some time after suspected parturition), a child is found, and a witness is required to state whether the time which has elapsed since the birth of the child, either dead or living, corresponds with the supposed delivery of a suspected woman. An opinion may be formed within eight or ten days after delivery (*vide supra*), but it becomes difficult after the sixth day; and when the tenth or twelfth day has passed it is still more difficult. After two or three months it may be regarded as impossible to assign the period of delivery with any degree of precision.

In a case of pretended delivery, contested legitimacy, or disputed chastity (*Fraser* v. *Bagley*, see "Defloration"), a medical jurist may be required to say whether a woman has, at any antecedent period of her life, been delivered of a child. Delivery has often been feigned by women for the purpose of extorting charity, compelling marriage, or disinheriting parties who have claims to an estate, and in other cases without any assignable motive. It may be said at once that unless the child, of which the woman is said to have been delivered, had been of at least six months' development, it is simply impossible to swear to the fact of her ever having been delivered at all, if we define "remote" as at least six months previous to examination. If it had reached this period some of the following may be found, but no one of them alone is of much use; it is absolutely imperative for many of them to be found, and then for other causes to be excluded which might account for them. They are:—

(*a*) **Breasts, Changes in.**—There is commonly a so-called secondary areola on the breasts of parous women, and that rather darkly pigmented, but these points, especially the pigmentation, may fade after lactation, and may be found in non-parous brunettes; the presence of the secondary areola is a little more reliable. The breasts in parous women are commonly pendulous, but the breasts of any woman may become pendulous from many other causes than a past pregnancy, and they may recover their shape and firmness very well after a pregnancy, and even after prolonged lactation. If *lineæ albicantes* (the little white, atrophic, glistening lines) can be found they are so far proof that the skin over the breast has been at some time greatly distended, but do not prove that pregnancy was the cause of it; excessive fat, or even an abscess, might cause such distension.

(*b*) **Abdomen with Lineæ Atrophicæ.**—The same arguments apply as to those in the breast, only that the possible causes are even more numerous than for the breast, ascites, tumour, œdema, fat, etc.

(*c*) **Vulva and Perineum.**—It is much easier, from the completeness of the posterior commissure, or absence of any rupture of perineum, or of a scar of such rupture, to say that probably there has not been parturition, than it is to state positively that there has been parturition because the appropriate opposite to the above is present; disease and accident may easily be alleged as the cause of what is found.

(*d*) **Hymen.**—An unruptured hymen is, of course, absolute proof against parturition having ever occurred (it is no proof of virginity, *vide* p. 29): if the attached margins of the fragments of lacerated hymen are in continuity with one another it may safely be sworn that no full-time child has passed; if *carunculæ myrtiformes* (these are the tags of tissue left by the ruptured hymen which do not touch at their seat of attachment) are present this is conclusive proof of considerable distension of the hymeneal orifice, but other things than a fœtus may have done this. [I have myself seen considerable distension and laceration produced by a cut-glass scent bottle.—Ed.]

(*e*) **Uterus Enlarged, and Cervix Lacerated.**—It is true that when once the uterus has carried a fœtus for many months it never again becomes quite so small or quite the same shape as one which has not done so; the differences are, however, such that in the living (even healthy) uterus they could not be positively asserted to be due to a past pregnancy, while disease such as fibroids will quite destroy any chance of ante-mortem distinction between a parous and non-parous uterus. The condition of the cervix is more reliable (*vide* above, "Signs of Recent Delivery"), though, of course, such lacerations may have entirely disappeared.

Signs of Remote Delivery in the Dead.

Death will not have destroyed any of those enumerated for the living unless decomposition or other destructive agency has been at work too long; they must therefore be looked for. The uterus may be more closely investigated and measured, the shape and size of its cavity and cervix measured, and also any disease such as fibroids can be for a certainty detected. For elaborate differences between the parous and non-parous uterus *vide* works on obstetrics.

SUB-SECTION E.—DIVORCE.

Whatever may be the view of ecclesiastical law upon marriage and divorce, the Civil Law regards marriage at any rate as a contract in which the due performance of the sexual act takes a very prominent place.

Legal Aspects of the Question.

To Mr. Digby Cotes-Preedy, Barrister-at-Law, the editor is indebted for the following epitome of the Law on Divorce in the High Court, and on the separation of man and wife by justices in lower courts, and on legal cruelty in such suits.

There is implied in this contract a capability of consummation, so that an incapacity in either party in this respect may constitute a legal ground for annulling the agreement:—

I. Dissolution of Marriage.—A petition for dissolution *a vinculo matrimonii* may be presented on grounds enumerated in section 27 of the Matrimonial Causes Act, 1857:—

(a) By a husband: for adultery of wife.

(b) By a wife: for husband's incestuous adultery; or bigamy with adultery; or rape; or sodomy; or bestiality; or adultery coupled with such cruelty as, if proved alone, would have entitled her to a judicial separation; or adultery coupled with desertion, without reasonable excuse, for two years and upwards.

II. Judicial Separation.—A decree for a judicial separation has the same force and consequence as a decree for a divorce *à mensâ et thoro* formerly granted by the Ecclesiastical Courts prior to 1857, and may be obtained either by a husband or a wife on the ground of adultery, or cruelty, or desertion without cause for two years and upwards.

III. Nullity of Marriage.—Under this heading come—

(A) Marriages void *ab initio*, such as bigamy, want of consent, consanguinity, or irregularity.

(B) Marriages only voidable—

(a) where either the husband or wife is incapable of consummating it by reason of impotence;

(b) or where one or both of the parties are under the legal age of consent to marriage (twelve for a female and fourteen for a male).

(c) For insanity—if a petition for nullity of marriage on the ground of insanity of respondent husband or wife is presented, the Court has to determine whether the respondent was capable of understanding the nature of the marriage contract entered into, free from the influence of morbid delusions on the subject; the Court does not determine whether the respondent was aware that he or she was going through the ceremony of marriage. The nature of the alleged unsoundness of mind must be considered as to whether it is of a character which might come on suddenly, or whether it is a matter of progressive growth and development (*Jackson, otherwise MacFarlane* v. *Jackson* (1908), P. 308, where the form of insanity was paranoia, or delusional insanity, a decree *nisi* for nullity being pronounced in favour of a wife-petitioner).

A person impugning the validity of a marriage on this ground has the burden of proving the insanity; but should the existence of permanent insanity be established, then the person seeking to uphold the marriage must satisfy the Court that it took place during a lucid interval. A marriage brought about by the exercise of undue influence over a mentally weak person may be set aside (*Portsmouth* v. *Portsmouth* (1828), 1 Hag. Ecc. 355).

IV. SUMMARY JURISDICTION (MARRIED WOMEN) ACT, 1895.—Under this statute a court of summary jurisdiction may order that a wife whose husband has been convicted of an aggravated assault upon her, or has been guilty of persistent cruelty to her, by reason of which she has been caused to leave and live separately and apart from him, shall be no longer bound to cohabit with him (which provision, while in force, shall have the effect in all respects of a decree of judicial separation on the ground of cruelty). A certificate of this conviction for cruelty may be used to corroborate a wife's allegations of cruelty in the Divorce Court (*Harriman* v. *Harriman* (1909), P. 123); but apparently the depositions taken before the justices may not be so used (*Judd* v. *Judd* (1907), P. 241). A wife may also obtain relief when she has been deserted by her husband—it is not required that it should have continued for two years and upwards. Also where he is found by the Court to be an habitual drunkard under the provisions of the Habitual Drunkards Act, 1879, and the Licensing Act, 1902.

LEGAL CRUELTY.—The definition of this matrimonial offence was laid down by Lord Stowell as far back as 1790, in *Evans* v. *Evans*, 1 Hag. Con. 35, and was approved by a majority of the House of Lords in *Russell* v. *Russell* (1897), A. C. 395. It is described as conduct of such a character as to have caused danger to life, limb, or bodily or mental health, or where there is a reasonable apprehension of its doing so.

Either a husband or wife may be found guilty of this offence. It is seldom that one act of cruelty is so serious as to be deemed sufficient by the Court; but where there are continued acts of bad treatment and ill-usage they will be considered as cruelty when taken together. Where the petitioner's health has broken down owing to a long course of conduct on the part of the other spouse, the Court will give relief. To wilfully and recklessly communicate syphilis or gonorrhœa is cruelty; but it would appear that in the absence of other and more serious acts it is not cruelty to infect a husband or wife with a mere skin disease.

A man cannot be convicted criminally of unlawfully and maliciously inflicting grievous bodily harm on his wife, or of occasioning her actual bodily harm, by reason of his having communicated to her a **venereal** disease from which he was suffering, although at the time of his having connection with her he was aware, and she was unaware, of his condition, viz., gonorrhœa (*R.* v. *Clarence* (1888), 16 Cox, 511). Drunkenness of itself is not regarded by the Court as cruelty, but a petitioner will be entitled to relief if the acts complained of were committed while under the influence and effects of drink (*Walker* v. *Walker* (1898), 77 L. T. 715).

The Court will protect a petitioner from cruelty by an insane spouse where the insanity is recurrent and intermittent, and the safety of the petitioner is in question (*Hanbury* v. *Hanbury* (1892), P. 222—husband suffered from intermittent and recurrent mania; *Baron* v. *Baron*, 52 Sol. Jo. 282—where the husband had twice attempted suicide, necessitating confinement in asylum for a few months, and on other occasions made threats against wife, so that her health became impaired). But it would appear from the remarks of Lord Gorell in Baron's case that if the insanity is of a permanent nature the remedy of the petitioner would be to apply the provisions of the Lunacy Act.

Threats of personal violence will often constitute legal cruelty; but abuse, obscene language, or even the act of spitting in a wife's face will not, if standing alone. Words alone, however galling, however violent, and even if they impute a crime of the most disgraceful kind, have been held not to constitute legal cruelty (*Russell* v. *Russell*, *supra*). Such conduct as the above, with other acts, such as false accusations of adultery (*Jeapes* v. *Jeapes*, 89 L. T. 74) or unnatural practices, may be regarded as coming within the definition and the principle of cumulative cruelty.

Medical Aspects of the Question.

Glancing at these in order, medical evidence may be required to prove: 1. **Adultery on the part of the wife.** This naturally involves the questions of prolonged and shortened gestation should she have become pregnant as the result of such intercourse: this we have already considered in full. Under ordinary circumstances the case calls for no medical evidence (except it be identity), and we shall take no further notice of it.

A husband cannot get a decree of nullity of marriage on the ground of his wife's fraud in concealing from him the fact that she was enceinte by another man at the date of the marriage (*Moss* v. *Moss* (1897), P. 263).

2. For the medical evidence to be given on the various offences in par. I. (b), the reader is referred to the appropriate section of this work. It would be a mere repetition to deal with them separately from our present point of view.

3. Medical evidence in regard to II. can only be required to prove cruelty which has been already discussed above and in the sections dealing with personal injuries in so far as ordinary cruelty is

concerned; there remain here for further mention (1) the communication of venereal disease, and (2) divorce for alleged impotency and sterility.

1. **Communication of Venereal Disease.**—It is difficult in view of the above legal aspects of this question to make any general statements on this subject, but gonorrhœa is frequently the subject of medico-legal inquiry from its widespread dissemination and the injury which may be produced in the female if the uterus, tubes, or ovaries become infected. In the last few years it has been conclusively shown that gonorrhœa is a much more formidable disease than was formerly believed, and further that the only accurate method of diagnosis is the bacteriological demonstration of the gonococcus of Neisser. It must, however, be remembered that even with this method the examination of the most diverse parts of the uro-genital system must be made before a definite opinion is given. A certificate of freedom from gonorrhœa to a marriage candidate should be granted by a doctor only after the greatest deliberation and after repeated negative examinations by a bacteriological expert. The absence of any discharge clinically is no evidence of the absence of gonococcus even years after an attack of the disease, and as long as the gonococcus is present the individual is capable of communicating the disease.

De Lisle v. *De Lisle* (1904).—In this case the wife sought a divorce by reason of the adultery and cruelty of her husband, the cruelty consisting in the alleged transmission of gonorrhœa, whereby her health was seriously affected. The respondent having had gonorrhœa within a year of marriage received a certificate from a medical practitioner that he was in good health on June 26th, 1902. On July 9th marriage took place, and was consummated in a violent manner, the petitioner being severely lacerated. Between July 10th and 12th connection took place four times, on each occasion accompanied by severe pain. On July 13th menstruation ensued and lasted some eight days, and marital relations were not resumed until July 27th, when at the request of the petitioner connection took place and continued twice daily until August 2nd. On all these occasions petitioner was free from pain. On August 3rd connection was attempted, but failed, as respondent was unable to get an erection. On August 4th respondent complained of feeling unwell, and consulted a doctor, but did not inform his wife of the result of his medical consultation. On August 9th, *i.e.*, six days after last coitus, petitioner noticed a discharge on her linen and felt smarting pains on micturition. Early in September she consulted a physician in Rome, as she had doubts whether her marriage had really been consummated. While answering this question in the affirmative, the physician in question was apparently led from the appearances presented to ask for an examination of the sheets of the bed occupied by the petitioner during her last period of marital intercourse. Stains were found on the sheets, and cocci similar in appearance to the gonococcus, and petitioner was thereupon seen by a venereal specialist, who pronounced the disease to be clinically gonorrhœa, and on examination of the pus the gonococcus was stated to have been found. The examination was microscopic only. No cultures were made. On the night of October 7th violent uterine hæmorrhage ensued, with the result that on the 9th the uterus was cleared out, and a putrefied fœtus was found. The petitioner was ill for many weeks, and as the result of her sufferings brought the action against the respondent. Medical witnesses were called for both parties, the defence being that the petitioner did not suffer from gonorrhœa, or if she did that it was an infection from a latent gonorrhœa in the respondent, he believing himself to be cured before the marriage took place. For the petitioner the medical expert opinion was that although no cultivation of the gonococcus had been made, the whole history of the case, together with the microscopic diagnosis, was proof of the existence of gonorrhœa. In the cross-examination the question of the existence of pseudo-gonococci was considered, also the possibility of the cause of the condition being due to leucorrhœa. On the other hand, the medical experts for the petitioner laid great stress on the fact that had the gonorrhœa been contracted from a latent gonorrhœa in the respondent, the discharge would have made its appearance long before August 9th, *i.e.*, thirty-four days after marriage. The fact of its appearance on this date was held by the medical experts to be conclusive evidence that there had been a fresh adulterous infection in the respondent some time between July 13th and August 3rd, and probably in the latter part of this period.

For the defence it was maintained that the disease from which petitioner suffered had never been gonorrhœa, that it might have been set up by a leucorrhœa the result of the violent intercourse with laceration which took place in the first instance, and that a mere microscopic diagnosis was totally insufficient to diagnose gonococcus, which might be closely simulated in appearance and staining reactions by other cocci in the urethra or cervix uteri. The respondent in cross-examination denied adultery, but admitted having had three separate gonorrhœic infections before marriage. He also admitted having consulted doctors about his genitals before he was even aware that the petitioner had contracted a discharge.

In giving judgment, the Judge dwelt at length on the medical evidence, and came to the conclusion that the diagnosis of gonorrhœa had been established even although the final test, the cultivation of the gonococcus, had not been carried out. He dwelt also on the inability of the defence to establish a diagnosis other than gonorrhœic. From the length of the incubation period it was held that the gonorrhœa must have been contracted by the respondent subsequent to marriage, the inability to have connection on August 4th and the subsequent visit to the doctor being evidence that the disease was then commencing. To establish the charge of cruelty, the Judge held that it must be shown that the respondent had a knowledge that he was suffering from the disease, or at least a suspicion that he was suffering, and this was held to be proved by the fact that on more than one occasion he consulted medical men before he was aware that the petitioner had contracted it. A decree *nisi* was therefore granted.

2. **Divorce for alleged impotency or sterility.**—The impediment constituting impotency may arise either from malformation, from that which the law calls frigidity of constitution, or from any physical cause of whatever nature which may render intercourse impossible. The suit for a sentence of nullity may be promoted by either party, and the medical proof required to found a sentence must be such as to satisfy the Court that the incapacity pleaded was in existence at the time of the marriage, and that it still remained without remedy.

In a suit which came before the Ecclesiastical Courts in 1845, a singular question arose whether, when there was a capacity for sexual intercourse on the part of a woman, with a certainty that from physical defect it could never be prolific, this was sufficient to entitle the husband to a divorce.

The woman was examined by Bird, Lever, and Cape, and they reported that the sexual organs were undeveloped, like those of girls who had not reached puberty, that the vagina was only three-quarters of an inch in depth, and that there was no uterus. They stated that sexual intercourse might take place in an imperfect way, but that conception could never result. On a second examination, seven months afterwards, it was found that the vagina had become elongated, and had then a depth of two inches; but there were no medical means of improving its condition or of removing the defect. It was contended for the husband that the defect was natural and irremediable, and that he was entitled to a sentence of nullity of marriage. On the part of the wife, it was insisted that, in order to entitle a party to this sentence, there must be an *utter impossibility* of sexual intercourse. The case, it was argued, was one of mere sterility, which was no ground for a sentence; actual consummation had taken place.

Dr. Lushington, in pronouncing judgment, said that mere incapability of *conception* is not a sufficient ground whereon to found a decree of nullity. The only question is, whether a woman is or is not capable of sexual intercourse; or, if at present incapacitated, whether that incapacity admits of removal? A power of sexual intercourse is necessary to constitute the marriage bond; and this intercourse must be ordinary and complete, not partial and imperfect; yet it would not be proper to say that every degree of imperfection would deprive it of its natural character. If it be so imperfect as to be scarcely natural, it is, legally speaking, no intercourse at all. As to conception, there is no doubt that the malformation is incurable. If there was a reasonable probability that the woman could be made capable of natural coitus, the marriage could not be pronounced void; if she could not be made capable of more than an incipient, imperfect, and unnatural coitus, then it would be void. Cape stated that under present circumstances there could be only a restricted and limited connection: it could not be called perfect and complete. The vagina might possibly become a little more elongated, but this would expose the female to danger. From these facts the marriage was pronounced null and void. (See *Amer. Jour. Med. Sc.*, Jan., 1848, p. 305.) Hence we may infer that if the vagina had been of its natural length, notwithstanding the absence of the uterus, and the impossibility of conception, a sentence of nullity would not have been pronounced. This is rather conflicting with the doctrine that the main object of a marriage, valid in law, is *ad proles procreandas*. (See "Ann. d'Hyg.," 1872, 2, 388.)

Negative evidence of non-consummation from the physical condition of a woman is of much less value, *cæteris paribus*, than the affirmative evidence from the existence of a physical defect in a man (*vide* "Impotence"). When the defect is not apparent on an examination, the case is attended with considerable difficulty. Divorce has, however, been granted even in these cases, when the husband has acknowledged his incapacity, and when, notwithstanding cohabitation for some years, this admission has been confirmed by an examination of the wife. Even when the male organs do not appear well developed, and sexual desire is absent, great caution is required in drawing up a report. In the case of Bury, the marriage was dissolved on the ground of impotency; but this man afterwards married another woman and had issue—a fact which proved that *ecclesia circumveniatur*. This gave rise to a difficult question, for it was contended, if the divorce was null, the second marriage was unlawful and the issue illegitimate. It was decided, however, that the second marriage was only *voidable;* and that, until dissolved, it remained a lawful marriage, and the children born during coverture were legitimate. In investigating a case of this kind, when there is no apparent physical defect or malformation, it is necessary to examine the bodily state of the person, whether he is effeminate, or, on the other hand, has about him any or all of the usual marks which attend the virile state. In the latter case the impotency may be only temporary; and it would be decidedly unsafe to pronounce an opinion adverse to the existence of procreative power.

From these considerations it will be perceived that, in order to justify a suit of divorce on the ground of impotency or sterility, the impediment to intercourse or procreation should be established by good medical evidence, and it must be *evident* and *irremediable* ; it must also have existed before the marriage of the parties, and have been entirely unknown to the person suing for the divorce ; if it has supervened after the marriage, this is no ground for a suit. The nature of the impediment is to be determined by private medical opinions or affidavits, based on an examination of *both* parties. There is one remarkable circumstance with respect to these cases, namely, that in nearly all of them, the suit is by the woman against the man ; although there is no reason whatever to suppose that impotency and sexual malformation are more common in males than malformation and sterility in females. We rarely hear of a husband instituting a suit of divorce on the ground of sterility (incapacity of procreation) in the wife ; and in most instances the wife promotes the suit on the ground of impotency or incapacity of intercourse in the husband. The difficulty of establishing incapacity in a woman, and the facility of proving impotency from physical causes in a man, may possibly account for this difference.

The following case is reported (Eulenberg's *Vierteljahrsschr.*, 1872, 1, 90). The malformation there described, which led to a suit of nullity, promoted by the husband against the wife, is probably not unfrequent among reputed females. If not detected at birth it may be detected at the age of puberty, and the unfortunate consequences of a matrimonial alliance prevented.

The plaintiff K. alleged that his wife was incapacitated for sexual intercourse, and demanded a separation from her. An examination of husband and wife was ordered. The husband, æt. 29, admitted that for the first quarter of a year after his marriage he had made no attempt to have connection with his wife, but after this time, on making the attempt, he found it to be impossible. He deposed that about eight days before his marriage he had sustained a serious injury to his genitals from the bite of a horse, and had been eleven weeks under medical treatment. Soon after his recovery, on attempting intercourse, he had reason to believe that his wife was differently constructed from other women. An examination of the husband showed that there was no deficiency or defect on his part. The wife, æt. 26, was a healthy-looking person. Her voice was rough, like that of a man, with shrill tones resembling those of a boy at puberty. The pomum Adami (larynx) projected as in a man. There was no appearance of breasts; the face was not hairy. There were some stiff hairs on the upper lip and chin. The pelvis was that of a male. There was a penis about one inch and a half long and one inch in diameter, with prepuce and glans, but no perforation for the passage of urine. This was below and behind the root of the organ (*hypospadias*, p. 24, *ante*). There were projecting labia, with a deep fissure between, in the situation of the vagina, about two inches in depth, and getting narrower as it proceeded backwards. No uterus could be felt. In one labium there was a perfectly well-formed testicle. The other contained none, but a testicle of smaller size was found in the inguinal canal.

Ettmüller informed the wife that there was more of the male than the female sex about her. She said she was well aware that she was not like other women. Her parents had concealed her condition from her, and had never consulted a medical man. She admitted she had never menstruated, and had not had any mucous discharges from the vagina. She had experienced but little sexual feeling, never towards men, but more towards women. She regretted her condition, and agreed to a separation from her husband. Ettmüller summed up his report by stating that the wife was an hermaphrodite, with more of the male than female development, that she was incapacitated for sexual intercourse as a woman, that the sexual defect was congenital, *i.e.*, existing before the marriage, and that the defect was incurable. The marriage was declared void, and the wife was ordered to put on the clothes of a man.

Suits of this kind are sometimes instituted many months and years after the union of the persons, and it is pretty certain that the case is started from, and often depends upon, some other cause, which the law would not recognise as sufficient of itself, while it would admit the plea of impotency. These suits, after protracted cohabitation, are always regarded with great suspicion. In one of these cases (*Castleden* v. *Castleden*, 1861, 9 H. L. C. 186) which came before the Divorce Court in 1860, the wife required a declaration of nullity of marriage on the ground of her husband's impotency. The parties were married in 1854, and cohabited until 1858. Of the three judges two were adverse to the petitioner's claim, and this was rejected. In *Marshall* v. *Marshall*, which came before the Court for Divorce in 1864, the wife petitioned for a decree of nullity of marriage on the ground of the impotency of the husband; the judge said that he was not satisfied that the petitioner's case was established. He would, however, suspend his decree, and intimated his opinion that the petitioner ought for the present to return to cohabitation. If she refused, he would make an order to compel her to return; or, if she wished to appeal, he would formally dismiss the petition.

Dr. Stevenson was once consulted by a husband who sought a divorce from his wife on the ground of her alleged inability to afford sexual intercourse. When he married her she was a widow, and had borne several children to her first husband. Her last confinement was a bad one, and the right thigh was firmly anchylosed at the hip-joint in such a position that the limb projected forward and to the left. The husband alleged that he was unable to have intercourse with his wife in any position. This seemed improbable; and obviously the woman, æt. 42, was not necessarily sterile. In the case of *Harris* v. *Harris*, tried a few years ago, a suit for nullity of marriage, there was anchylosis of both hip-joints in the wife. Nevertheless, there was abundant evidence that there had been repeated sexual intercourse from behind (*more feriarum*).

The following case, which came before the Divorce Court in 1868, involved the novel question whether these suits of nullity were restricted to the husband and wife during life, or whether third parties could intervene to promote them for their own interest after the death of either.

The plaintiff claimed a right to administer the estate of his deceased wife, who had died intestate. He made the claim as her lawful husband. The next-of-kin of the wife, who were the defendants in the case, contended that, by reason of physical incapacity, the marriage with the intestate was void, and he was not the lawful husband. He therefore had no legal right to claim administration.

Sir J. Wilde said that a distinction must be made between void and voidable. In cases of physical incapacity the marriage is not void, but voidable under certain conditions. Thus the party complaining must be sincere on the ground on which he is asking relief. There must be no unreasonable delay, and the physical defect must be incurable. This matter of incapacity ought to be raised only by the person who suffers any injury from it, and who elects to make it a ground for asking that the contract of marriage should be annulled. Such a question can only be discussed and adjudicated in the lifetime of the parties. It is a matter of *personal* complaint only, and has always been dealt with as such. In this suit the rights of third parties had been introduced. The question whether two persons are married or not may arise on a variety of occasions, and be raised by third persons, as creditors or otherwise. Now if the parties themselves are content with the *consortium vitæ,* and prefer to maintain the bond of matrimony intact, would it not be almost intolerable that a third person should have a right to insist upon an inquiry into the nature of their cohabitation and the revelation of their physical defects? The ground of nullity must therefore be confined to a suit brought by one of the parties to the marriage in the Matrimonial Court. He pronounced the contention of the defendants to have wholly failed, and gave judgment for the plaintiff, the husband, whereby, notwithstanding physical incapacity, he was constituted administrator to his deceased wife's estate.

Either husband or wife may petition the court as soon as either spouse discovers that the other is incapable of sexual intercourse; the three years' cohabitation as a condition precedent to a decree of nullity no longer exists.

Medical Evidence—Note by Cotes Preedy.—The doctor is a frequent witness in the Divorce Division of the High Court. He is called to speak as to the character of injuries upon which a wife may be relying in order to substantiate her charge of cruelty. The effect of a husband's conduct (not physical cruelty) upon the health of the wife and the probable consequences if it is continued is almost daily considered by both the family physician and the specialist. Before venturing to testify as to the presence, or absence, of venereal disease, it behoves a medical witness to come prepared to show that he has approached and dealt with the case in a scientific manner—for instance, has made use of the microscope in cases of gonorrhœa. Very recently the question as to whether a husband had had syphilis or not came before the court, and medical witnesses were called by both sides. Dr. H. W. Bayly, of the Lock Hospital, was one of the experts that gave evidence, and based his opinion on the results obtained by the Wassermann reaction. The ultimate decision arrived at by the court was probably due to his scientific testimony. So important is medical testimony in nullity suits that an order for the appointment of two medical inspectors must be obtained from a Registrar of the Divorce Division when a suit is ready to be set down. The inspectors, who are previously sworn, make a report to the Registrar after examination of the parties. Either side can obtain a copy of the report. As will be seen from the cases above referred to, the refusal of a respondent in a nullity suit to be examined does not prevent the suit proceeding. Rarely a nullity suit is contested, but if so, there may be medical evidence in addition to the inspectors who have to give evidence in support of their report. Medical men are frequently called to give evidence as to the virginity or not of a female co-respondent. The presence of a hymen is generally received by the court as sufficient evidence of the accused being a *virgo intacta.* About a year ago, the wife of a publican brought a suit for divorce against her husband, a barmaid being associated with the respondent in the charge of adultery. The suit was strenuously defended. Two medical men gave it as their opinion, without any reasons, that the barmaid was a *virgo intacta*. The counsel for the wife, either through ignorance or caution, did not cross-examine the witnesses as to the signs of virginity, but the husband's counsel in re-examination, doubtless feeling absolutely safe, hazarded to one of the doctors the question, "In what condition was the hymen?" "I did not see any hymen," was the reply, which considerably astonished the counsel. The judge, a man of large experience, pursued the point to such an extent, that on the following day the husband did not contest the allegation of adultery any further. A more striking illustration of "let well alone" can hardly be conceived. Medical men should be on their guard to see that when a female is examined for such a purpose there is no juggling of the identity of the person to be examined and the person actually inspected.

The following selection of cases are taken from Rayden's "Practice and Law in the Divorce Division":—

(*a*) **Decrees Granted.**—*D.* v. *A.* (*otherwise D.*), 1 Rob. Ecc. 279.—Where wife had no uterus, the vagina forming a *cul de sac*—complete coitus being impossible.

W. v. *H.* (*otherwise W.*), 1861, 2 Sw. & Tr. 240.—Consummation impossible owing to congenital malformation of wife, which was only removable at considerable risk to her.

G. (*otherwise T.*) v. *T.*, 1854, 1 Ecc. & Ad. 389.—Parties separated at end of three months. Wife had imperfect signs of virginity or of connection, husband believed to be incurably impotent.

G. v. *G.*, 1871, 2 P. & D. 287.—A wife of middle age had successfully resisted husband for about three years—no malformation, but refused to submit to remedies owing to dangerous nature.

P. v. *L.* (*otherwise P.*), 1873, 3 P. D. at foot of p. 73.—Wife aged eighteen and hysterical. Struck husband when attempts were made. Threats to commit suicide. Said she had no sexual desire and refused remedies.

H. v. *P.* (*otherwise H.*), 1873, 3 P. & D. 126.—After three years' cohabitation, husband's attempt excited hysteria. Wife refused examination.

L. v. *L.* (*otherwise W.*), 1882, 7 P. D. 16.—Wife aged twenty-three, with vaginismus, slept on occasions with husband for three years. Slightly dangerous operation refused.

F. v. *P.* (*otherwise F.*), 1896, 75 L. T. 192.—Respondent a widow, not a virgin, without children. Slept with second husband five months. Non-consummation admitted. Decree granted on ground of "latent incapacity arising from hysteria."

E. v. *E.* (*otherwise T.*), 1900, 50 W. R. 607.—Full intercourse resisted by wife for six months. Inspection refused.

B. (*otherwise H.*) v. *B.*, 1901, P. 39.—Eight months after the marriage separate beds against wish of wife. Subsequent attempts in same bed. Wife unwillingly executed deed of separation. Husband refused examination.

R. (*otherwise K.*) v. *R.* 1907, 24 T. L. R. 65.—Before marriage, wife seduced by another man. Husband admitted impotence.

S. v. *S.*, (*otherwise M.*) 1908, 24 T. L. R. 253.—Wife refused. No attempt by husband. Examination refused.

J. (*otherwise K.*) v. *J.*, 1908, 24 T. L. R. 622.—Where husband refused to give up habit of self-abuse and left wife.

L. (*otherwise B.*) v. *B.*, 1895, P. 274.—Wife delayed bringing suit for seven years.

S. v. *B.*, (*otherwise S.*) 1905, 21 T. L. R. 219.—Decree granted seventeen years after marriage.

(*b*) **Decrees Refused.**—*U.* (*otherwise J.*) v. *J.*, 1867, 1 P. & D. 460.—Assertion of wife not accepted by court. Medical evidence uncertain. Denial by husband.

S. v. *A.*, (*otherwise S.*) 1878, 3 P. D. 72.—Husband and wife had lived together nine years, but court was not satisfied as to husband's attempts.

S. (*otherwise E.*) v. *E.*, 1863, 3 Sw. & Tr., 240.—Permanent incapacity not assumed by court. Two attempts during three months' cohabitation, unsuccessful owing to husband's habit of self-abuse, probably curable. Wife's health affected.

SUB-SECTION F.—LEGITIMACY AND PATERNITY; LEGAL PRESUMPTION OF LEGITIMACY.

Every child born either in lawful matrimony, or within a period after the death of the husband in accordance with the natural duration of gestation, is considered by the English law to be the child of the husband, unless the contrary be made clearly to appear by medical or moral evidence, or by both combined. It is only in reference to *medical* evidence that the subject of Legitimacy can here be considered; but it is extremely rare to find a case of this kind determined by medical evidence alone. There are generally circumstances which show that a child whose legitimacy is disputed, is the offspring of adultery, while the *medical* facts may be perfectly reconcilable with the supposition that the claimant is the child of the husband. These cases, therefore, have been repeatedly decided from *moral* evidence alone—the medical evidence respecting the period of gestation or physical capacity in the parties leaving the matter in doubt. The common law of this country was, according to Lord Coke, to the effect, that if a child was born during marriage, the husband being within the four seas of the realm (*inta quatuor maria*), and no physical impossibility being proved, the child was legitimate. Access was presumed unless he could prove that he was "*extra quatuor maria*" for above nine months previous to the birth (Blackstone). But the present state of the English law on the subject appears to be this. A child born during marriage is deemed illegitimate when, by good medical or other evidence, it is proved that it was *impossible* for the husband to be the father—whether from his being under the age of puberty, from his labouring under physical incapacity as a result of age or natural infirmity, or from the length of time which may have elapsed since he could have had intercourse, whether by reason of absence or death. With proof of non-access or immorality on the part of the mother, so important on these occasions, a medical witness is not in the least concerned. In a case of voluntary separation of husband and wife, which the law does not recognise, the children born are the children of the husband, unless non-access can be clearly proved.

In a case before Kindersley, V.-C. (*Atchley* v. *Sprigg*, 33 *Law Jour.*, Chan., p. 345), it was proved that husband and wife had lived together nine years without having had a child, and that they then separated and did not live together again. Ten years after the separation, and while the wife was in the habit of committing adultery with another man, a child was born. This child was treated by the paramour as his own, was called by his surname, and was brought up by him. Its legitimacy was contested, and the Vice-Chancellor decided that, notwithstanding the possibility of access on the part of the husband, the child was illegitimate. It was held that in this case there was convincing evidence of illegitimacy, although access was possible.

Another case decided by the same judge (*Plowes* v. *Bossey*, February, 1862) shows, that where there is nothing strongly to affect the character of the woman, a child will be held to be legitimate, although the opportunity of intercourse may have been of the slightest possible description. Mr. Atkinson has favoured the editor with the following note and references. The presumption in favour of the legitimacy of a child born in wedlock, within the usual period of gestation, is a presumption which may be rebutted by appropriate evidence.

In a suit to perpetuate testimony, Earl Poulett, who died in 1899, deposed that he had never had intercourse with his wife (who less than six months after the marriage gave birth to a full-grown child) before marriage; that soon after his marriage his wife confessed that she was pregnant by another man, and that thereupon he separated from his wife, and never acknowledged the child:—Held, that the evidence was admissible against the child's legitimacy (*Poulett Peerage Claim* [1903] A. C. 395, H. L. (E.)).

The adultery of the wife, although throwing the greatest doubt upon the paternity of the child, is not conclusive. It must be shown that the husband could not have had access which might result in paternity; otherwise the presumption of sexual intercourse between husband and wife, and consequently of legitimacy of the child, must prevail (*Gordon* v. *Gordon & Granville Gordon* [1903] P. 141, Jeune, P.).

In some instances, the law assumes without medical evidence that the offspring is illegitimate, as where the husband and wife have been legally divorced previous to the nativity "*a vinculo matrimonii.*"

There is a peculiar difference in relation to legitimacy, between the laws of England and Scotland. A child born of parents in Scotland before marriage is rendered legitimate by their subsequent marriage. In England the offspring is illegitimate, whether the parents marry or not after its birth; but under the Poor Law Act (4 & 5 Will. IV.), if a man marry a single woman having a child or children living, of whom possibly he is not the father, he is bound to maintain them as if they were his own, and born after marriage. At the same time the children are not legitimated by the marriage. In the case of *Birtwhistle* v. *Vardill* (7 Cl. & Fin. 895) decided on appeal by the House of Lords in 1840, it was held that a child thus legitimated by the law of Scotland could not be allowed to succeed to his father as heir to real estate in England (see case of *Dalhousie* v. *M'Douall*, House of Lords, 1840). These suits are chiefly instituted in respect to the right of succession to real estate or in claims for peerages; and medical evidence is then frequently required to clear up the case.

MEDICAL EVIDENCE OF LEGITIMACY.

The medical evidence, then, that may be required will refer to the following facts, which will be considered in order:—

Has this woman had a child? } "Supposititious
If so, is the alleged child of the age required? } children."

If the woman has had a child, and no question is raised regarding substitution, its legitimacy must depend upon:—

On the part of the husband
1. Physical competency.
2. Access within reasonable time involving—
    - (a) Natural duration of pregnancy.
    - (b) Shortened ,, ,,
    - (c) Prolonged ,, ,,

From what has been stated, it will be perceived that the English law does not regard the date of *conception*, which cannot be fixed, but the date of *birth*, which can be fixed. It appears that, hypothetically, a child born *after* the death of the wife, provided she has been lawfully married, is legitimate, although the marriage is legally dissolved by the death. Two cases are quoted in which living children were born after the death of the woman; these facts are of especial interest in relation to tenancy by courtesy. Whether the birth takes place by the aid of art through the outlet, or by the Cæsarian section, the husband, if the wife be at the time dead, cannot legally claim the estate; but the child thus born out of marriage is legitimate, and if it live may, on attaining its majority, take the estate of which the mother was seised (see "Cæsarian Extraction," *infra*). The fact that the English law disregards the time, place, or date of conception might therefore give rise to a singular question. A child may have been conceived before the marriage of the parents, and be brought into the world by the Cæsarian operation after the death of the mother: hence it would neither be *begotten* nor *born* in wedlock, and yet, according to the principles of the English law, it would be the legitimate offspring of the marriage.

It sometimes happens that a child is born after the death of the husband. Conception is assumed to have taken place during wedlock, and although the child is not born in wedlock, the presumption is in favour of legitimacy, unless non-access or physical incapacity be distinctly proved. Hence *conception* during wedlock, and *birth* after the dissolution of the marriage by death—or conception before wedlock and birth during that state—or conception and birth during lawful wedlock, equally create a presumption in favour of the legitimacy of offspring.

Has this Woman had a Child at all?—This has been considered fully on pp. 67 *et seq.*, *q.v.* The only point that requires to be mentioned here for emphasis is that if the child has survived (which it has *ex hypothesi* of legitimacy), it must have been of at least six months' intra-uterine development, and therefore the marks left by its birth have been and still may be manifest. The woman also may be demonstrably sterile (*vide* p. 20 *et seq.*, also Vol. I. "Consent for Examination").

Is the Child Produced of the Age Required?—If only a medical practitioner be on his guard when called to a case of labour in a hurry by persons who have not previously engaged him, a mistake of this kind is not easy.

A woman may substitute the living child of another woman for a dead child of which she herself has been delivered, or for a mole which may have passed from her. So, again, a male may be substituted for a female child, and *vice versâ*. The practising of a fraud of this nature may seriously affect the rights of inheritance of parties; but it cannot be accomplished without great dexterity and cunning, or without the co-operation of several accomplices. One instance occurred at Chelsea, in 1842, where the fraud was brought to light by the death of the supposititious child. The calling in of a professional man would lead to discovery, when the question was simply whether the delivery had or had not taken place; but if it is alleged that one *living* child has been substituted for another, the proof of this can depend on medical evidence only when the age of the supposititious child does not happen to correspond to the date of the pretended delivery (*vide* "Age"). The legitimacy of the claimant of the Douglas Peerage was disputed on this ground, but apparently without foundation (see "Paternity"). An instance of this description will be found in Henke's *Zeitschr. der S. A.*, 1845, 2, 172); and a trial has taken place in England, involving the alleged substitution of a child, but requiring no medical evidence for its elucidation (*Day* v. *Day*, Leicester Lent Ass., 1845). In another case it was proved that a woman had substituted a doll for the dead body of a child of which she pretended she had been delivered. In a case mentioned by Chevers,

One Mussamat Janoo, a midwife of Hissar, being employed to attend a woman in her confinement, persuaded her that the child of which she had been delivered was a monster with two heads, not fit to be looked at; and she afterwards said that it was dead, and she would take it away and bury it. She accordingly went away. Next morning, her services being required, the midwife was sent for, but she excused herself from going under the pretence that she had just been delivered of a child. This improbable story excited suspicion, and the police were called in; the midwife declared that the child was her own. This she also maintained at the trial. It appeared, however, from the evidence of other midwives who examined her shortly after the discovery of the child in her house, and also from the deposition of the civil-surgeon, that she exhibited no signs of recent delivery. Several of the neighbours, who were constantly in the habit of seeing her, deposed that she had not exhibited any outward signs of pregnancy. She did not attempt to prove how she had disposed of the body of the child, which she alleged had died immediately after its birth. This was proved to be a false statement; she had taken possession of the child of which the woman whom she attended had been delivered, representing it as her own. She was convicted ("Med. Jurispr. for India," p. 512).

The manner in which an imposition of this kind may be carried out is well shown by a case which occurred in France.

The woman was in this instance married. She was deaf and dumb, and it appeared that her husband was in collusion with her. It was not in her power to make any disposition of some property to which the children of the marriage would be entitled, and by the advice of her husband she simulated pregnancy, in order to deprive the heir-at-law of the property to which, if she died childless, he would be entitled at her death. The facts, as far as they could be ascertained, were as follows:—The woman was 42 years of age, and although she had been married for a period of twenty years, had borne no children. On this occasion she said she was delivered without any medical assistance. All her acquaintances and friends were ready to depose that for six months she had presented the usual progressive appearance of real pregnancy, and that she had manifested the usual indisposition attending this state, including occasional faintings at church, etc. For the heir-at-law it was contended that she had substituted, in her false accouchement, the child of a person named Peyrins, born only a few days before the date of her pretended confinement, and that she had made a false declaration of the birth. A midwife was ready to depose that the deaf and dumb woman had never been a mother. The decision in this case is not stated ("Ann. d'Hyg.," 1847, 1, 463).

It is obvious that it can only be by the coincidence of simultaneous delivery of another woman whose pregnancy is unsuspected, that a trick of this kind can be successfully practised. In all cases there must be a feigning of recent delivery, which a medical man of moderate acumen would be able to detect (*vide* Sub-section D.)

Cases involving a question of substitution of children are not very common. One of these (*Hutchins* v. *Hutchins*) was heard in May, 1851 ; and in this the amount of ingenuity required to perpetrate the fraud was only equalled by the skill with which the facts were exposed. Other cases have come before the Courts.

In *R.* v. *Skepelhorne and wife* (C. C. C., February, 1870), the prisoners were charged with conspiring to deceive a man named Ironside, by falsely representing that his wife had given birth to a female child. Mrs. Ironside, the wife, was in collusion with the accused. She had been married about nine months, and had given her husband the impression that she was pregnant. In conjunction with the prisoners she procured tho child of another woman, and this woman came forward as a witness at the trial. A woman acting as nurse was also examined, and stated that she had procured a "sheep's pluck," which was subsequently treated like the after-birth on the night of the pretended delivery. The facts were so patent that medical evidence was not necessary to prove that Mrs. Ironside had not been delivered of a child.

A medical man may learn from this case that the marks of blood about the sheets or in the room, or the alleged burning of the after-birth, may in these cases admit of an entirely different explanation. The prisoners were convicted.

A somewhat similar case was tried in December, 1870 (*R.* v. *Mary Hall*, C. C. C.).

The prisoner had here conspired with a woman to make it appear that she had been delivered of a child. The nurse hired for tho occasion was not allowed to be present during the alleged delivery, the prisoner acting as midwife. When the nurse was called into the room, she was shown by the prisoner the usual marks of a recent delivery, and on proceeding to wash the child, she found that it had already been washed, and was not a new-born unwashed child. It was thon proved that the prisoner had on the day of the pretended delivery procured the child of another woman who had been attended by a medical man, and who gave confirmatory evidence on this point. Farre said that he attended the woman after the alleged birth, and from what he saw he was sure that she had never given birth to a child. He then charged her and the prisoner with fraud. The prisoner was convicted.

In this case it will be perceived that the prisoner had cunningly waited until she could procure a new-born infant, and had then fixed the false delivery for the same day.

These, it will be seen, were attempts at fraud, easily detected and exposed when medical men were called in, or when all the parties concerned were not in collusion.

A more daring attempt of this kind came before the House of Lords in 1870, in reference to a claim for the earldom of Wicklow (*The Wicklow Peerage case*, Com. for Privileges, April 1, 1870).

The title and estates of the Earl of Wicklow passed at his death to his brother's issue. The first in succession was Georgo Howard, who, had died in October, 1864. He was married, in February, 1863, to Ellen Richardson, tho daughter of a coachman. In default of issue tho estates devolved on his brother Charles, the second in succession. Ellen Howard (late Richardson) produced a male child, who, she alleged, was born on May 16th, 1864, and this child, if such were the case, would be the son of her husband Georgo Howard, and consequently tho rightful Earl. Mrs. Howard was at the time in lodgings, and tho lodging-house keepers, Mr. and Mrs. Bloor, and a sister of the latter, one Rosa Day, were the principal witnesses in favour of the claimant. Mrs. Howard was, or professed to be, taken suddenly ill at the date mentioned. Mrs. Bloor went for a doctor, who was not at home, and on returning he was told that Mrs. Howard had been confined, and he saw an infant in Rosa Day's arms. This was the whole of the evidence of the child's parentage. The Lord Chancellor observed that the evidence was given by the witnesses with a firmness of demeanour and an absence of hesitation which would have commanded credence, unless it had been contradicted by all the surrounding circumstances. Neither medical man nor nurse attended Mrs. Howard, although it was her first confinement, and the infant would have been a seven-months' child. It was never registered, and never baptized. There was further strong evidence that she had not borne a child, and that the child which she had produced as her own was obtained by her in August, 1864, from a girl who had been recently delivered in a workhouse. Mrs. Howard was clearly identified as the person who had taken away a child from the workhouse at this time. Her story was thus proved to be false. The House of Lords decided against the claim, and came to the conclusion that the witnesses had been guilty of perjury.

Fraud may be fairly suspected in cases of this kind, when a woman has not been attended by a medical man, and when there is, as there always must be, an unexplained mystery about the surrounding circumstances. A medical man of character may be called in to attend a woman some time after an alleged delivery, and unless he is well upon his guard, his name and reputation may be used as a shield to cover a gross imposture. In this case he should take nothing for granted; but should firmly insist upon having a knowledge of all the facts, and see all the parties alleged to have been present at the delivery. He must not trust to the appearances of blood in the room, or the appearances of a burnt placenta, for these conditions may be easily imitated by an artful midwife.

The case of *Gedney* v. *Smith* (Rolls Court, November, 1864) is in this respect instructive. The fraud was nearly successful, and but for the dying declaration of the woman, would probably have wholly escaped detection and exposure.

The plaintiff claimed to be the only child of Mr. and Mrs. Gedney, and to be entitled to property under a marriage-settlement. Mr. and Mrs. Gedney were married in May, 1851; from that time to 1854 there was no issue, although it was stated there had been several miscarriages. Mrs. Gedney, alleging that she was pregnant in 1853, came to London, and took lodgings there in the early part of 1854. On February 10th in that year she was apparently seized with the pains of labour, and sent for a man, calling himself Dr. Goss, who, it was stated, delivered her of a female child—the plaintiff in this case. Mr. Gedney then came up to London, dismissed Goss, with whom he was dissatisfied, and consulted Farre. The substance of his evidence at the trial was that he was called in, as a perfect stranger, to attend Mrs. Gedney in her confinement on the Tuesday, the lady having been confined on the Friday previously; that he attended her from February 14th to March 7th; that it was an ordinary case of confinement—there was nothing unusual in the mother or child; that the child looked three or four days old when he first saw it; that he had no doubt he pursued the same mode of attending to the case as was resorted to in other similar cases, such as putting his hand on the uterus, abdomen, etc.; that it was not possible the lady could *not have been confined at all*, etc. The evidence of the reputed father, Gedney, was that his wife, according to her own statement, was pregnant in 1853, and in February, 1854, she came to London, not to be confined, but for the purpose of procuring medical advice. He registered the child and treated it as his own up to the time of his wife's death in March, 1857, and it was not until then that he had any doubt that the plaintiff was his child. On the part of the defendant, it was alleged that Mrs. Gedney had *not* been delivered of a child. Porter, her physician, who

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examined her body after death, deposed to this effect; and another physician, who attended her for venereal disease in September, 1853, stated that he did not believe that she was at that time pregnant. Three of the female servants of the family, who were much about her, and saw her undressed, deposed that when she left for London in February, 1854, there was no appearance of her being pregnant. This was confirmed by the lodging-house keeper and other persons who had full opportunities of judging of her condition. It was further proved that Dr. and Mrs. Goss (the latter with a bundle under her cloak) called at the house on the afternoon of the day on which Mrs. Gedney was said to have been confined, and that they were alone in the room for some hours with Mrs. Gedney. During this time (from 4 to 11 p.m.) no nurse was procured, and no noise of a child was heard; but various articles were asked for, and on the landlady entering the room in the evening, she was shown a baby; but it had no redness of skin about it like new-born children. She also saw some marks of blood, etc., about the fireplace, and Goss told her that he had burnt the after-birth. It was further shown that on February 4th (Mrs. Gedney was alleged to have been confined on the 10th), a woman named Lydia Fletcher was delivered of a female child at the York Road Lying-in Asylum; and that on February 10th a gentleman and lady—afterwards identified as Dr. and Mrs. Goss—had called at the hospital, and induced Lydia Fletcher to consent to give her child to them, in order that it might be adopted by a lady, who would bring it up as her own.

The child of Fletcher was proved to have been remarkably fair, with blue eyes, and this corresponded to the description of the child brought to the lodgings on February 10th. There was a total absence of parental likeness, as Mr. and Mrs. Gedney were dark. To support further the defendant's case, a clergyman was called, who swore that Mrs. Gedney voluntarily confided to him that the plaintiff was a supposititious child, which she had adopted in order to recover the affections of her husband by appearing to have become a mother. This statement was borne out by a lady's-maid of Mrs. Gedney, who swore that her mistress had confided to her the whole secret of the deception put upon her husband and family: the testimony of the two differing mainly in the fact that to the former Mrs. Gedney was alleged to have stated she had been confined of a still-born child, and to the latter that she had never been confined at all. Mrs. Gedney had subsequently, it was alleged, made to her father, on her death-bed, a confession of the whole deception; and this was the statement which came to the knowledge of Mr. Gedney on the day of his wife's funeral, and first raised in his mind a doubt whether the plaintiff was his own child. The jury returned a verdict for the defendants, thus denying the fact of the plaintiff being the child of Mr. and Mrs. Gedney.

The remarkable part of this case is that the fraud had nearly succeeded. It had been perpetrated ten years before the trial, and did not come to the knowledge of the husband until after his wife's death. Was this woman delivered of a child at all? According to Porter, who examined her body after death, she had never borne a child. The reasons for this opinion are not given, but it is to be presumed that he found the uterine organs in the virgin state. Farre, who was called in to attend her after the dismissal of Goss, stated that he saw her every day for the first week, every alternate day for the second week, and during the third week rather oftener. His opinion was that she had certainly been delivered of a child. The conflicting evidence on a simple matter of fact in this case points to the necessity, on the part of a practitioner, of making accurate notes of obstetric cases which come before him in a mysterious manner. These notes should include, not only the medical facts, but the reasons upon which the opinions are based.

In a more recent case, Meadows readily detected the imposture by the age of the child, and the absence of signs of recent delivery.

Salisbury v. *Rawson* (Queen's Bench Division, before Mr. Justice Hawkins, May, 1895) is the most recent case of an attempt to force a "supposititious child." The case was remitted from the Chancery Division by Mr. Justice North to try if an alleged posthumous child was the daughter of Mrs. Salisbury. The question of illegitimacy in its usual sense was not raised. An income of considerable amount (£800 to £1,500 a year) depended on the verdict.

Mrs. Salisbury, æt. 38, had had several miscarriages and expected to be confined in April, 1895. On February 23rd, 1895, she was alleged to have been delivered of a full-term child (female)! She had previously objected to espionage by remaindermen. Her married sister was alone with her when child was alleged to be born [it being asserted (1) door would not open; (2) bell would not ring! (3) it was about 2—3 a.m., but no time-piece was in room]—a local medical man saw her 16—18 hours after alleged delivery: he examined neither mother nor child (obstetrically); he appeared satisfied and stated the child was full-time; some days later she refused to be examined by him (beyond the condition of mammæ, *no milk*)—she did not nurse child, but fed it on condensed milk soon after alleged birth—when she went into widow's mourning, she was not measured by her dressmaker—she denied producing an abdominal pad and calling it "the baby." The child's birth was registered, and she was churched. The soiled linen was kept in room for four days. Several women had noted signs of pregnancy (size and symptoms), but she was never medically examined as to her gravidity before the alleged birth.

Dr. Horrocks was called as an expert to state that child's condition, as given by witnesses, showed it was not a neonate.

A medical man gave evidence of finding Mrs. Salisbury a neonate to adopt on the day of the alleged birth. It was the female child of a single woman, which was not registered in its native district.

Verdict: the alleged daughter was spurious.

A full report of the case appeared in the *Times* newspaper, May, 1895.

The latest *cause célèbre* of this class comes from Germany, where in 1903 Countess Kwilecka was accused of having put forward a supposititious heir. The editor is unable to obtain a copy of the whole of the medical evidence, but the following remarks by some of the experts are so much to the point as to deserve to be recorded here.

Dr. Duerssen, after a lengthy statement of facts and theories, declared that he believed that the accused countess did not give birth to a child in 1897.

Professor Freund, gynæcologist, on the contrary, stated that one could not base any scientific opinion upon mere suppositions; but in the case on trial there had been altogether too much conjecture and too few facts. He characterised as mere suppositions nearly all the points upon which Dr. Duerssen based his opinion that the countess had not given birth at the time stated. He said the mental condition into which many mothers fell after childbirth would explain the curious attitude of the countess towards an experienced physician.

A third expert, Dr. Stormer, said that from a medical point of view he considered all the evidence in this case referring to the childbirth in 1897 as absolutely valueless either in favour of or against the accused. Still, he thought there was an unusual accumulation of suspicious circumstances.

In the end the countess was acquitted.

Physical Competency on the Part of the Husband.—This has already been fully considered (*vide* "Impotency," Sub-section A). It calls for no further remark here beyond a caution as to cryptorchism, *q.v.*

Opportunities of Access on the Part of the Husband.—On legal aspects of what constitutes access nothing more than has been said above needs to be inserted here.

For medical purposes we have only to consider the duration of natural pregnancy. (For a full discussion of the average and its limits either way *vide* above, Sub-section C, pp. 38 to 63.) Here we need only state that the **period of gestation is not fixed by law.** In all cases of contested legitimacy, the question respecting the duration of gestation, when it arises, is left entirely open by the English law. The French law allows 300 days, and the Prussian law 301 days; but no period has been fixed by English jurists within which, or beyond which, a child, if born in wedlock, will be presumed to be illegitimate. The decision of a court of law would be founded *quoad* the duration of pregnancy on the opinions of experts selected for the occasion, and each case would be decided on its own merits. Precedents can have but little influence on these occasions, because a court may think fit to pronounce illegitimate, on non-medical grounds, a child born in the thirty-eighth week of gestation, while it may decide that another was legitimate that had been born in the forty-third week. By some law authorities *forty* weeks (or 280 days), and by others forty-three weeks (or 301 days), have been taken as the *ultimum tempus pariendi;* but as the period of human gestation is wholly independent of any legal *dictum,* it is not the custom of courts to act upon this as a rule. Nevertheless, it is clear in some extreme cases that the law may fairly interpose, and pronounce for a reasonable limit.

The editor would suggest that a fixed limit would save litigants much expense and witnesses much perjury. The limit might be fixed more liberally than by the French and German laws, and might be made applicable to cases of contested legitimacy only.

We may now record some legal trials in which the question of the duration of pregnancy has been raised.

In the case of *Cotterall* v. *Cotterall* (Consistory Court, July, 1847), a child was born during the marriage, and the husband proceeded against the wife for a divorce on the ground of adultery. The main proof was based on the fact that in order to have been the child of the husband, it must have been born after *twelve months'* gestation. The husband left his wife in New South Wales, and was absent for that period of time without possibility of access. The judge (Lushington), without entering into the question of protracted gestation, upon proof of this allegation, at once pronounced for the divorce.

Such a duration of pregnancy is not supported by any known facts, and is altogether opposed to medical probability.

In an affiliation case at the Thames Police Court (October, 1857), proof was afforded that the putative father had been absent from England eleven months and six days before the child was born, and on this evidence the case was at once dismissed. A husband and wife had parted on January 23rd, 1858, the husband going to the West Indies. A child was born on December 29th following, *i.e,* 339 days (or forty-eight weeks and three days) from the time at which the husband parted from the wife. The child died, and a claim was made on a life insurance society for a sum of money alleged to be due to the parents on account of this child. The society refused payment on the ground that the child was illegitimate.

The author's opinion was adverse to the claim; the length of the alleged gestation, and the state of the child when born, were deemed sufficient to prove that it was not the child of the husband.

In *Anderton* v. *Gibbs* (1834), it was decided that a child born ten months (or about *forty-two weeks*) after intercourse with the husband was legitimate. A verdict had already been returned establishing the legitimacy of the plaintiff; and an attempt was now made to set this aside, among other grounds upon the plea that the offspring was illegitimate, because it had been born at so long a period after possible access. It appeared that the mother of the plaintiff, for some time before and at the period of the birth, had been living in adulterous intercourse. The legitimacy of the plaintiff was established. From this case it will be seen that a child may be affiliated on the husband, although the wife may be living at the same time in adulterous intercourse with another person.

Few trials in relation to legitimacy have excited more attention among jurists than the Gardner Peerage case, which came before the House of Lords in 1825. A full account of the medical evidence was published by Lyall ("Med. Evid. in Gardner Peerage Case," 1827).

Alan Legge Gardner, the son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the Parliament Roll. The peerage was, however, claimed by another person, Henry Fenton Jadis, *alias* Gardner, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter son was illegitimate; and in order to establish this point, the evidence adduced was partly medical and partly moral. Lady Gardner, the mother of the alleged illegitimate child, parted from her husband, on board of his ship, on January 30th, 1802. Lord Gardner went to the West Indies, and did not again see his wife until July 11th following. The child whose legitimacy was disputed was born on December 8th of that year. Therefore the plain medical question, taking the extreme view, was whether a child born 311 days (*forty-four weeks and three days*, from January to December) or 150 days (*twenty-one weeks and three days* from July to December) after possible intercourse could be the child of the husband, Lord Gardner. If these questions were answered in the affirmative, then it followed that this must have been either a premature or a protracted birth. There was no pretence that it was a premature case, the child having been *mature* when born. The question then was reduced to this—Was this alleged protracted gestation of 311 days consistent with medical experience? The principal obstetric practitioners in the kingdom were examined on this point. Their evidence was conflicting, but a majority concurred in the opinion that natural gestation might be protracted to a period which would certainly cover the birth of the alleged illegitimate child. On the moral side of the question, it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jadis; and on this ground Lord Gardner obtained a divorce from her after his return. He subsequently married a second wife, by whom he had the claimant, Alan Legge Gardner. It was contended that the other claimant was really the son of Lady Gardner by Mr. Jadis. The decision of the House was that this claimant was illegitimate, and that the title should descend to the son of the second Lady Gardner.

The decision appears to have been chiefly based on moral circumstances: for had not the first Lady Gardner been living in adultery at the time of her husband's departure, it is highly probable, from the medical evidence bearing strongly that way, that the legitimacy of the child would have been admitted. Again, supposing the child had been born two or three weeks earlier, the question would have resolved itself into this:—Who had begotten the child—the husband or the adulterer? This could not have been decided, and then probably, as in the more recent case of *Anderton* v. *Gibbs*, the rule of law would have pronounced the husband to have been the father. Morally speaking, the decision could not be impugned, but medically speaking it assumed that gestation could never be protracted to the 311th day after probable intercourse. Considering that conception is not necessarily the immediate result of intercourse (*vide*, p. 43), and that we have no data for fixing the precise time of its occurrence, this decision could hardly be supported on medical grounds. We should not be justified in affirming that every child born forty-four weeks and three days after the opportunity of intercourse with the husband was *ex necessitate rei* an illegitimate child. Of the seventeen medical experts examined on this occasion, five supported the opinion that the duration of human pregnancy was limited to *about* nine calendar months, *i.e.*, from thirty-nine to forty weeks, or from 273 to 280 days —or, strictly speaking, from 270 to 280 days; one of the witnesses, indeed, said from 265 to 280 days. These witnesses, of course, gave a negative to the possibility that Henry Fenton Jadis, *alias* Gardner, could have been the product of 311 days' gestation. On the other side, of twelve medical men who seemed to agree respecting the above-mentioned period as the natural term of gestation, the greater number maintained the *possibility* of pregnancy being protracted to nine and a half, ten, or even eleven calendar months, and of course to 311 days —the alleged term of gestation at which the counter-claimant was born—and they thus admitted the possibility that H. F. Jadis, *alias* Gardner, might be a ten-and-a-half-months child (Lyall's "Med. Evid. on the Duration of Pregnancy," p. 8).

In a well-marked instance of gestation from a single intercourse, noticed by Reid, the interval was 293 days; and by referring to the case of *Rigby* and *Merriman*, it will be seen that the periods of gestation from a single intercourse have varied to a much greater degree than the two here placed in comparison. The following case was tried in the United States in 1844 (*The Commonwealth* v. *Porter*, Cambria county, Pa.). The facts were somewhat similar :—

> The defendant was indicted for fornication and bastardy. The prosecutrix, aged twenty-three, stated that she had had intercourse with the defendant on September 24th, 1842, and with no other person before or subsequently. She was delivered of a child on August 7th, 1843, *i.e.*, after 317 days, or *forty-five weeks and two days' gestation*; and she swore that the defendant was the father of the child. The menses ceased about three weeks after intercourse, and they only appeared again slightly about five weeks before the child was born. At this time she had pains which continued more or less until her delivery. She first knew that she was pregnant three or four weeks after intercourse.
>
> The defence was that, from the period of time which had elapsed, the defendant could not have been the father of the child. He therefore merely proved his absence and did not return until after the birth of the child. No evidence was adduced to impeach the character or conduct of the woman. It was proved that she had always borne a good reputation, and that she had been seduced by the defendant under a promise of marriage. Rodrigue deposed that, in a practice of nineteen years, he had attended some hundreds of cases of midwifery, and the longest period of gestation which he had known was *ten months*. He considered the pains described by the prosecutrix to have been the commencing pains of labour. The Court charged the jury strongly in favour of the medical testimony on protracted gestation, and they returned a verdict of guilty, thereby finding that the defendant was the father of the child. It transpired that a wife of one of the juryman had during one pregnancy gone ten months (*Amer. Jour. Med. Soc.*, October, 1845, p. 338).

Rodrigue, who reports this trial, states that a case subsequently came to his knowledge in which there was reason to believe that gestation had continued for a period of 320 days.

It would appear that the question of protracted gestation is frequently raised in the United States under these circumstances. Another case of bastardy (*The Commonwealth* v. *Hooner*) was tried in 1846, in which the alleged duration of pregnancy must have been 313 days, or forty-four weeks and five days.

The prosecutrix deposed that she had had intercourse with the defendant on March 23rd, 1845, and not subsequently—a fact established by the evidence; and the child, a large, healthy male, was proved to have been born on January 30th, 1846. Twelve obstetric physicians were examined on this trial. Some regarded it as possible, but not probable, that gestation might be so protracted as to reach 313 days. Various medical works were quoted on the subject. The Court charged the jury that, although unusual and improbable, this length of gestation was not impossible; and they returned a verdict finding that the defendant was the father of the child (*Dub. Med. Press*, November 4th, 1846, p. 296). In the case of *Dyson* v. *Dyson* (Vice-Chan. Court, February 18th, 1852), it was proved that the husband left his wife in Madeira in February, 1849, that she returned to England in August following, and that the child whose legitimacy was contested was born on January 8th, 1850. It was contended that this was a case of protracted gestation; and the evidence of several medical men, to the effect that gestation might be protracted to 330 or even 336 days, was quoted in support of this view; in this instance there was a period of 336 days. The Vice-Chancellor, having referred to the Gardner Peerage case, declined to make a decree in favour of the legitimacy of the plaintiff (*Legal Examiner*, February 21st, 1852).

In *Renouf* v. *Eden* (Q. B., February, 1870), an action was brought by a milliner against defendant for seduction.

The plaintiff and defendant met in the island of Guernsey, and it was admitted that an intimacy had existed between them. The defendant left the island on April 15th, 1867, and did not return to it. The plaintiff was delivered of a child on February 15th, 1868, *i.e.*, 307 days or forty-four weeks *minus* one day, after the departure of the defendant. There was no evidence that the plaintiff, either before or subsequently, had had connection with any other person.

On the part of defendant, it was contended that he could not possibly have been the father of the child, seeing that, if so, there must have been a period of gestation of over 300 days, which it was contended was physically impossible. Upon this point two physicians were called on each side. Tanner and Clark, for the plaintiff, declared that though 275 days was the usual period of gestation, they had known cases of 297 or 300 days; and there was in medical books cases of still longer periods. On the other hand, Tyler Smith and Barnes were called, and stated that in their belief the current of medical opinion ran now strongly in an opposite direction, and went to narrow rather than extend the limits of possible gestation; and though they would not go so far as to say that it was absolutely impossible that the period should extend to 300 days, they believed it so improbable as to be practically incredible. On the part of the plaintiff, a case was quoted to show that, even although the child was not the defendant's, yet if he had incited the girl to leave her mother's roof, and then seduced her, the mother was entitled to recover. The Lord Chief Justice agreed in this, and directed the jury that the main issue did not turn upon the medical evidence, for that only went to probabilities, but on all the probabilities of the case. A verdict was returned for the plaintiff, with damages. The medical witnesses on both sides agreed that the gestation might be protracted to the extent which would have made the defendant the father of this child.

The following report of a case is taken from the *Lancet*, 1900, 1, p. 1078.

A couple, named Somers, who had been married for more than a year, but were childless, separated on or about August 12th, 1876, and paid visits in different houses, never apparently meeting again. On September 11th the wife wrote to her husband to state that she had eloped with a man named Millward, but in the divorce petition which ensued the date of adultery was fixed as September 7th, and the decree was granted without apparently that date being questioned. On June 18th, 1877, after the decree *nisi* had been granted, but before it had been made absolute, a child was born. This child, now a young man of full age, was registered on baptism as the child of Millward, and was, it would seem, treated as such by all those connected with him until questions arose as to dealing with certain funds held in trust under the marriage settlement of Mr. and Mrs. Somers. To a share in these trust funds the child was *primâ facie* entitled as a son born during the continuance of the marriage—*i.e.*, before the making absolute of the decree of divorce; and a suit in the Chancery Division to compel the trustees to deal with the funds led to an action in the Queen's Bench Division, the question for the jury being whether there was or was not issue of the marriage of Mr. and Mrs. Somers. A child born in wedlock is by law presumed to be the child of the husband until it is proved that it is impossible that this can be the case. Now the dates show that the child of Mrs. Somers was born 281 days after her admitted elopement with the co-respondent and 285 days after the date named in the petition as that upon which the adultery took place, while August 12th, the date given as the last proved opportunity of access to Mrs. Somers by her husband, would make the period of gestation of a child born to him 311 days, precisely the period named in the case ef protracted gestation recorded in our columns by Dr. Phillips. Had Dr. Phillips been called as a witness to prove his experience, he would probably have been asked to admit in cross-examination that the date of coition given by him rested on the evidence of the patient in question, who would be likely as a single woman and a child in years to minimise her fault by asserting a single act of unchastity to have occurred, and thus would fix the date of her first fall rather than the date of any subsequent lapse as the only possible date of her impregnation. Dr. Phillips's testimony was, perhaps, not invited, because of the weakness which we have indicated, but it would have undoubtedly weighed heavily with those members of the first jury who saw that the evidence of the numerous medical witnesses called before them was inconclusive. For if this evidence went to prove that it was exceedingly unlikely that the child was the child of Mr. Somers, it did net, and could not, prove that the protracted gestation was impossible, while Dr. Phillips's case would have been a well-authenticated example of the abnormality the existence of which was under dispute.

At the trial before Mr. Justice Lawrance and a special jury, the difficulty of establishing more than extreme improbability was no doubt felt by the learned counsel who sought to disprove the legitimacy of the child, and he consequently strengthened his case by dwelling at length on circumstances extraneous to the medical evidence, and these undoubtedly aided him considerably in his contention. The question to be decided was not whether it was or was not possible that under certain conditions a child could be born at so long an interval of impregnation as 311 days, but whether there was or was not issue to a particular marriage. As relevant to this specific point evidence was given that at the trial of the divorce petitien the wife sought to establish a counter charge of impotency against her husband. This she did not succeed in maintaining, but the evidence of the husband, which was read in court before Mr. Justice Lawrance, showed that the sexual relations between the pair was unhappy, and not such as pointed to a probability of issue of the marriage. Moreover, the wife appears to have complained to her family in respect of this very matter before she decided to leave her husband. Other evidence of fact was given on both sides with regard to the possibility and impossibility of access during the weeks which were alleged to have been spent by husband and wife paying visits apart from one another; but the jury, who declared themselves satisfied that there was no issue of the marriage without waiting to hear the concluding addresses of counsel, or the summing up of the judge, must be taken to have accepted this interval in conjugal life as proved. Beyond this they no doubt considered that the normal period of about 275 days assigned by the medical witnesess before them pointed very strongly to the child being that of the co-respondent, while the probability of the abnormal gestation of 311 days having occurred was minimised by the relations proved to have existed between husband and wife. It will be noted that neither husband nor wife gave evidence, obvious considerations of decency precluding two persons from being allowed to contradict one another on oath in open court on questions of the greatest privacy, involving the bastardising of the child of one or both of them. When all the circumstances and probabilities of an adulterous connection are considered it will be felt that the finding of the jury in the Somers case was reasonable, and, in all probability, correct, although such questions must always involve doubt and difficulty on the part of those called on to determine them.

Cases in Reference to Proof of Access.—In the case of *Cope* v. *Cope* (North Spring Circ., 1833) an action was brought by the plaintiff for his share of a legacy, to a part of which he declared himself entitled, as being the son of the deceased's testator's brother. There was no doubt that the plaintiff was born during lawful wedlock; but it was contended that he was an illegitimate child—therefore it remained with the defendants to establish his illegitimacy by evidence. The defendants rested their case, first, on the entry in the parish register, which represented the plaintiff to be an illegitimate child; secondly, on *non-access* between the husband and wife. The husband, having separated from the wife, went to reside at about fourteen miles' distance from her. He was absent for several years; but it was contended that he was always within a short distance of the wife. During his absence the wife formed an illicit connection with another man, and at this time the plaintiff was born; but it was rendered probable that the husband had visited the wife before and after the birth of the child. It appears that both the woman and her husband regarded this child as illegitimate; and an attempt was made, on the part of the defendant's counsel, to put in declarations to that effect. But the court interposed, and Alderson, B., said—"Lord Hardwicke had decided that the mother could not be allowed to give evidence on such a point, as she could not discharge the husband of the birth of the child; and *à fortiori* the husband could not be permitted to discharge himself. Lord Mansfield and Lord Hardwicke had both decided that illegitimacy could be proved only by the fact that there had been no marriage, or by proof of non-access; and it was held, on the grounds of decency and morality, that the parties themselves should not be allowed to prove non-access after their marriage." In summing up, he further observed that—"If a child be born in marriage during the lifetime of the husband, that child in law is presumed to be legitimate. The plaintiff in this case is the youngest child, and was born after four other children, and during the lifetime of the reputed father; and he is in law, therefore, legitimate, unless the fact were proved, which it was for the jury to decide upon, viz., that the husband had not had opportunities of access. If a husband have access, and others at the same time have criminal intimacy with his wife, still a child born in such a case is legitimate in the eye of the law. But if the parties are living separate, and the wife is notoriously living in open adultery, and the husband have opportunities of access, yet under such circumstances it would be monstrous to suppose that he would avail himself of these—then the legitimacy of a child, so born, could not be established." The jury returned a verdict for the plaintiff, finding that he was legitimate.

The case of *Morris* v. *Davis*, which came before the Lord Chancellor in 1830, was a suit of contested legitimacy which had been pending for eighteen years; and which was finally left by both parties to be disposed of by the judgment of his Lordship, on the facts and on the law of the case. The plaintiff was the son of a Mrs. Morris, and claimed to be the son of the husband; but it was contended that, although born in wedlock, he was illegitimate. The husband and wife had voluntarily separated, but lived for many years within a short distance of each other. The wife was living in adultery; and fourteen years after the separation from her husband, this child, the plaintiff, was born. The wife saw her husband occasionally, but concealed the birth of the child from him. The man with whom she was cohabiting always treated the child as his own; and Mr. Morris remained for seventeen years in ignorance of its birth, or even of its existence. His Lordship said the question was one of fact, and not of law. There was an apparent difficulty in the case, owing to this—that the parties, although separated, were proved to have met occasionally; there was therefore, unquestionably, opportunity of access—but it so happened that *none of these meetings would correspond with the time requisite for the birth of the child* to render it legitimate. This fact, together with the general bad conduct of the mother, and her open adulterous intercourse, led him to pronounce that the plaintiff was an illegitimate child—that he was not the son of Mr. Morris. In the case of *Gurney* v. *Gurney* (Vice-Chanc. Court, May, 1863) a similar question arose, but the evidence clearly established that there had been no access in the interval between December, 1859, and the date of the child's birth in May, 1861. In the case of *Plowes* v. *Bossey* (February, 1862), the Vice-Chancellor decided in favour of the legitimacy of a child, although the husband was confined in a lunatic asylum—on the ground that the wife visited the lunatic, and intercourse might have taken place in spite of the watchfulness of the keepers.

In another case (*Atchley* v. *Sprigg*, January, 1864), Vice-Chanc. Kindersley said that a child born of a married woman is presumed *primâ facie* to be legitimate—that is, to have been procreated by the husband—and our law respected and supported the legitimacy of such child; and although it did not prohibit any person interested from making out the illegitimacy, it threw the *onus probandi* entirely upon him. If the case made by such a person was that the husband and wife were never together within the period during which, according to the law of nature, they must have been to make the child the child of both, or that they were together either in company or under circumstances making the fact impossible, the onus was on him to prove, and not on the other side. Moreover, where evidence was brought forward to prove illegitimacy, the court did not treat the matter on the balance of probability, and the evidence must be such as to produce a judicial conviction that the child was not procreated by the husband. The question the judge had to ask himself, therefore, was whether, having considered the whole evidence, his mind was left in such a state as to convince him that the husband was *not* the father of the child. He was convinced, upon the whole, not that there was an impossibility that the husband ever could have had sexual intercourse with his wife (for that the law did not now require), but that such intercourse never did take place either during the period when the child must have been begotten, or at any other time from the year 1824, when they separated, until his death. Upon the whole, therefore, the case of the claimant must fail, the evidence of illegitimacy being such as to exclude all doubts.

The following is from *The Times* of June 28th, 1904:—"Prob. Div. and Admiralty Div. (before Mr. Justice Gorell Barnes), *Evans* v. *Evans and Blyth.* Judgment in this legitimacy issue, which had been reserved, was to-day delivered. It will be remembered that on June 9th, 1903, Surgeon-Colonel Evans obtained a decree *nisi* for the dissolution of his marriage with Mary Florence Evans, *née* Dickinson, on the ground of her adultery with Major Blyth (*vide The Times*, June 10th, 1903). This decree was made absolute on December 21st last, and there being (according to the petitioner's view) no living issue of the marriage, he on December 30th filed a petition for variation of settlements. The respondent had, however, on July 31st, 1903, given birth to a child, which Major Blyth had on September 16th, 1903, registered as his child and that of the respondent, a fact which that lady herself had on many occasions admitted both before and since the birth of the child. Accordingly, on May 11th last, the court directed an issue to be tried as to the paternity of the child, the plaintiff being the petitioner in the divorce suit, and the defendants the respondent, her child, appearing by the official solicitor as guardian *ad litem*, and the trustees of the marriage settlement (*vide The Times*, May 12th, 1904, and 20 *The Times* Law Reports, 516). The hearing of the issue has been reported fully in *The Times* June 17th and 22nd.

"Mr. Justice Gorell Barnes, in delivering his considered judgment, said that the question he had to decide was whether the child Beatrix Mary was Surgeon-Colonel Evans' child or not, the issue having arisen in the course of an application to vary settlements. The respondent and the trustees had been made defendants, but they had in fact been struck out of the issue and had taken no part in the proceedings. The law was quite clear as to the presumption of a child born in wedlock being legitimate. That was the old maxim, '*Stabitur huic præsumptioni donec probetur in contrarium.*' The leading case in these questions was *Bosvile* v. *Attorney-General* (12 P. D. 177), the head-note to which was as follows:—'The presumption in favour of the legitimacy of a child born in wedlock is not a *presumptio juris et de jure*, but may be rebutted by evidence, which must be clear and conclusive and not resting merely on a balance of probabilities.' In that case Lord Hannen in his summing up referred to the judgment of Lord Lyndhurst in *Morris* v. *Davies* (5 Cl. & F. 163), in which that very great judge said:—'My lords, this then is the view I have always taken of the law connected with this subject; at the same time, as I before expressed and I now feel, that presumption of law, which is that a child born in wedlock is the child of the husband, that presumption of law is not lightly to be repelled. It is not to be broken in or shaken by a mere balance of probability; the evidence for the purpose of repelling it must be strong, distinct, satisfactory, and conclusive.' Lord Hannen concluded as follows:—'It will be for you to say whether the evidence does establish to your mind conclusively, not by way of conjecture, but by way of conviction, that the child was not begotten by the husband.' The verdict of the jury in *Bosvile* v. *Attorney-General* was subsequently upheld by the Divisional Court. The learned judge then critically reviewed the evidence, pointing out that the wife's written confession, dated February 14th, 1903, and the fact of the child having been registered on September 16th, 1903, by Major Blyth and the respondent, was not evidence of the truth of the facts therein referred to, but was evidence of the parties' 'conduct.' To use the words of Mr. Justice North in *Burnaby* v. *Baillie* (42 Ch. D. 282):—'I treat the evidence of the statements made by them, not as evidence of the truth of the statements which they made, but merely as proving that they did make those statements, thus showing what their conduct was at the time.' The difficulties in these cases arose from the old rule of law which prevented parties from themselves giving evidence as to the illegitimacy of their children, although such evidence could be called on their behalf. The broad features of the case were that the petitioner and the respondent had not been living as husband and wife before the date of her departure for Hagbourne on or about October 26th, 1902, and that Major and Mrs. Blyth had been her guests there until November 4th, when Mrs. Blyth only had left. The usual period of gestation was 280 days, although it varied from 270 to 290, and there was a recorded case in the books of 308 days. Taking the period from November 4th, 1902, to July 31st, 1903, the date of the child's birth, there had elapsed 269 days; but it was to be remembered that in June, 1903, the doctor and nurse were engaged by the respondent for her confinement, which she expected about August 12th. There was also Major Blyth's admission that he had committed adultery with the respondent at Hagbourne early in November and that she had joined him after she left her husband in February, 1903, and had lived with him since. Further, there was the evidence as to the respondent's state of health during the time that Mrs. Blyth was at Hagbourne. In these circumstances, he found as a fact that the presumption of law had been rebutted, and that Surgeon-Colonel Evans was not the father of the child Beatrix Mary, born on July 31st, 1903."

It will be seen, by the foregoing cases and remarks, that in these suits of contested legitimacy, the general practice consists in establishing the possibility of access on the part of the husband; when this is proved, the medical question arises, whether the term of gestation falls within the limits assigned by the best medical experience.

From the cases we learn what kind of evidence the law requires in order to establish access or non-access. In order to defeat the legal presumption of access, where husband and wife are living near to each other, something more than mere probability of non-intercourse must be adduced.

PATERNITY.

Disputed Paternity. Parental Likeness.—It has been stated that the law does not pretend to determine who begat a child when it has been born during wedlock. But medical jurists have recommended that family likeness should be looked to on several occasions—not merely a likeness in *feature* and figure, but in gesture and other personal peculiarities which may have characterised the alleged parent. These are called questions of *paternity*: they seldom occur except in reference to cases of bastardy, and when they do present themselves, the evidence thus procured, even if affirmative, is properly regarded as only corroborative. In the Townshend Peerage case (House of Lords, May, 1843), a presumption based on family likeness was admitted by their Lordships. The person whose legitimacy was in question was sworn by one of the witnesses to be so strong a likeness as a child to the alleged adulterer that he should have known him among five hundred children.

The proceedings in the Douglas Peerage Case (1767—9) show that evidence of this kind is occasionally of some importance.

The peerage was claimed by Archibald Douglas—the survivor of two brothers after the death of the alleged parents, Sir John and Lady Douglas. The claim was disputed, on the ground that the appellant and his deceased brother were supposititious children. Evidence for and against the legitimacy of the claimant had been collected from every quarter, and after it had been most minutely sifted and criticised, the case came on for judgment, in the Court of Session in Scotland, on July 7th, 1767. So important was the cause deemed, that the fifteen judges took eight days to deliver their opinions.

The result was that seven of the judges voted in favour of the identity or legitimacy of Archibald Douglas, *alias* Stewart, and seven against it; the Lord President, who had the casting vote, agreed with the latter, thus furnishing one among numerous instances that judges as well as doctors can differ with precisely the same facts before them. An appeal from this decision was taken to the House of Lords by which the judgment of the Court of Session was reversed in 1769, and Archibald Stewart (or Douglas) declared to be the son of Lady Jane, the sister of the previous holder of the title. Much stress was laid, in favour of the legitimacy of these children, on the fact that they closely resembled—the one Sir John and the other Lady Douglas. The resemblance was said to be general; it was evident in their features, gestures, and habits. Lord Mansfield, in delivering judgment, made the following remarks, which comprise all that can be said on this subject:—

"I have always considered likeness as an argument of a child being the son of a parent, and the rather as the distinction between individuals in the human species is more discernible than between other animals. A man may survey ten thousand people before he sees two faces exactly alike; and in an army of a hundred thousand men every man may be known from another. If there should be a likeness of feature, there may be a difference in the voice, gesture, or other characters, whereas a family likeness runs generally through all of these: for in everything there is a resemblance, as of feature, voice, attitude, and action."

This kind of evidence has been strongly objected to from its uncertainty; and it was in this instance much disputed whether one of the children did resemble Lady Douglas, but it seems to have been generally admitted that the other child resembled the husband, Sir John. From this account it will be seen that evidence from family likeness is not strictly medico-legal; it can be furnished only by friends and relatives who have known the parties well, and are competent to speak of the facts from personal acquaintance with them. It will also be apparent that the affirmative evidence in such cases will be stronger than that which is negative, for it could hardly be inferred that a person was illegitimate because he did not resemble his parent.

Parental likeness may be occasionally indicated by colour or peculiarities belonging to the varieties of mankind, as of the intermixture of the Negro or Mongolian with one of the Caucasian variety. In such a case the evidence afforded becomes much stronger; and supposing that two men of different nationalities have intercourse about the same time with the same woman, the colour of the skin of the offspring might possibly enable a court to determine the question of paternity. It is stated to have happened, on more than one occasion, that a black woman has given birth at the same time to a black child and a mulatto; and Cunningham refers to a case in which a negress gave birth to twins, one a black and the other a white child (*Lancet*, May 9th, 1846, p. 525). This was probably a case of superconception. In *Stothard* v. *Aldridge* (Bail Court, January, 1856), the plaintiff sued the defendant for damages for the seduction of his wife. The defendant was a man of colour, and the child born of the alleged adulterous intercourse was proved by the medical witness to have been born coloured and with woolly hair. The husband and wife were both light. This peculiarity fixed the paternity of the child on the black defendant.

Personal deformities are not necessarily transmitted from parent to child; yet it would appear that a disputed question of affiliation has been settled on this principle. A woman alleged that a gentleman in whose serivce she had lived was the father of a child of which she had been recently delivered. The case rested chiefly on the fact that the child had been born with five fingers and a thumb on the right hand, the defendant himself having been born with a similar malformation on both of his hands. It was argued, on the other side, that the deformity might have arisen from the mother's imagination, as, while pregnant, she was constantly in the habit of seeing the defendant. The magistrates decided that he was the father of the child, and condemned him to pay the necessary expenses for its support (*Med. Times*, March 6th, 1847, p. 47). This defendant might have been the victim of a coincidence. Six-fingered children are, it is well known, born occasionally of five-fingered parents: and as the deformity existed only on one hand in the child, while it was on both hands in the parent, the medical proof that it was actually transmitted by generation was not clearly made out. In some instances attempts have been made to fix the paternity of the child by the *colour of the hair*, but this evidence is far less conclusive than that afforded by the colour of the skin.

In the case of *Frazer* v. *Bagley* (February, 1844) it was alleged that the wife of the plaintiff had had criminal intercourse with the defendant, and the last two children were stated to be the offspring of the latter. The plaintiff and his wife had dark hair, as well as all the children with the exception of the two last:—these had red hair; it was further proved that the defendant had red whiskers and sandy hair.

No particular stress was laid upon this evidence, but it was received as a kind of indirect proof. Not much confidence can be placed in facts of this description, since red-haired children are often born to parents who have dark hair; and in one case the children born in wedlock were observed to have dark and red hair alternately (*Lancet*, 2, 1904, p. 1541).

Affiliation.—Questions of paternity are involved in those relating to *affiliation*. A party may allege that he is not the father of a particular child, by reason of certain circumstances upon which a medical opinion may be required. The necessary transmission of gonorrhœa or syphilis by intercourse may thus become a medical question.

In 1844, a man was required, under the law of bastardy, to support two children alleged by a female to be his; the time of gestation was within nine months. The accused denied that he had had intercourse with the woman, or that he could have been the father, since he was at the time under medical treatment for venereal disease.

The medical questions may therefore assume this shape:—1. Are these diseases invariably transmitted by intercourse? 2. Do they interfere with the act of procreation? Under common circumstances they must both be answered in the negative.

A case of bastardy occurred in Appenzell, Switzerland, where the question was, which of two persons, who had had intercourse with the same woman within a period of *seventeen days*, was the father of an illegitimate child borne by the woman? The Council, to which the case was referred, gravely resolved to postpone their decision until the features of the child were so far developed as to enable them to decide from *paternal likeness* (Schneider's "Ann. der Staatsarzneik," 1836, B. 1, s. 470).

Two men, A. and B., had intercourse, unknown to each other, with a young woman of delicate health, and after this had continued for some years, she was delivered of a female child—nine calendar months and three days after sexual intercourse with A., and nine calendar months, less five days, after similar intercourse with B.; or at the end of 279 days after intercourse with A., and at the end of 271 days after intercourse with B.—that is, a period of *eight days* elapsed between the periods of intercourse of the two men. The woman had no menstrual discharge in the meantime, and it is not believed that she knew any other man; she went her full time, had a good labour, and produced a fine healthy girl; she had a plentiful supply of milk, and enjoyed better health during her pregnancy and suckling than at any other time. The woman died, and the circumstances of the mixed intercourse having become known to A. and B., they both refused to maintain the child. A. contended that, as the woman was not delivered until nine months and three days after the connection with him, it was physically impossible that the child could be his. B. contended, on the other hand, that 280 days, and not nine months, is the period of gestation; and that the child having been born 279 days after connection with A., and only 271 days after connection with B., it was therefore probable that the child was begotten by A. There was no perceptible likeness to either of the men in the child, but a marked likeness to the mother (*Lancet*, March 13th, 1847, p. 336).

The periods of 271 and 279 days are comprised within the ordinary range of gestation: hence there would be no *medical* ground for affiliating the child to one man more than the other. Wachs reported a case in which the question was, whether a child could have been begotten on the day of the marriage or on an intercourse had with the woman sixteen days before (Horn's *Vierteljahrsschr.*, 1870, B. 2, s. 66). The length and weight and other characters of the child showed that it was mature, and had reached its full development, but this would not suffice to justify a medical opinion on the precise date of conception. Such a question does not admit of any definite answer in reference to paternity, the dates of intercourse being too close together.

When two men have intercourse with the same woman on the same day, it is impossible to settle the paternity except by the accident of likeness. In cases of affiliation under the law of bastardy, the evidence of the mother, if corroborated, is received in support of a question of disputed paternity; sometimes these cases are decided by the length of the period of gestation. A man may prove, or a woman may state, that the intercourse took place at such a remote period as to be inconsistent with the ordinary duration of pregnancy. In the United States it appears that very long dates are allowed in bastardy cases; while in this country the tendency is to reject medical evidence altogether. In a case at Cheltenham (July, 1853)) the date of intercourse was proved to have been 319 days before the birth of the child. The medical evidence on the whole was in favour of this protraction—one of the witnesses having met with two cases in which gestation was protracted, as he believed, to 310 days from intercourse—but the case was summarily dismissed.

Posthumous Children.—It has been supposed that a case involving a question of paternity might present itself on the marriage of a widow soon after the death of her first husband. If a child were born before the lapse of ten months, it might be a question whether it was a child of the first or second marriage—of the dead or the living husband; and although there might be no dispute concerning its legitimacy, yet it would be difficult to settle its *paternity*. Such a case appears hypothetical. In order that any doubt should exist, a woman must marry within, at the furthest, *six weeks* after the death of her first husband, or the birth of the child would fall beyond the furthest limit of gestation, so far as he was concerned. The customs of society are, however, a bar to such marriages; and admitting that a child was so born, and that it might be the offspring of either husband, then the fact of its having been born during the marriage of the second husband would presumptively fix the offspring upon him, unless it could be shown that there was no possibility of access on his part. If there was a supposed greater likeness to the first than the second husband, still this would not be allowed to defeat the legal presumption of the real parentage of the child. Evidence much stronger than this would be required for such a purpose.

SUB-SECTION G.—RAPE.

This subject will be considered under the following heads :—

1. Definition of the crime.
2. Age relations of rape.
3. Mental condition of victim.
4. Time for bringing an action.
5. Special cirumstances under which rape may take place.
6. Medical aspects of rape.
7. Rape on infants and children up to the age of sixteen.
8. Rape on women and girls over sixteen.
9. Disappearance of evidence.
10. False charge of rape.
11. Pregnancy following rape.
12. Rape on the dead.
13. Rape by females on males.

Definition of the Crime.

Rape is defined in law to be the carnal knowledge of a woman by force and against her will. For a long period it was punished as a capital crime in this country, but penal servitude or imprisonment was substituted by the 24 & 25 Vict. c. 100, s. 48. Under this section it is enacted that—

> "*Whosoever shall be convicted of the crime of rape shall be guilty of felony, and being convicted thereof, shall be liable, at the discretion of the court, to be kept in penal servitude for life, or for any term not less than three years, or to be imprisoned for any term not exceeding two years with or without hard labour.*

Since these changes have been made in the law, it has been alleged that the crime has undergone a considerable increase.

In the Criminal Law Amendment Act of 1885 certain conditions are laid down as regards age, mental condition, etc.; and since the passing of that Act certain decisions have been given on the subject. These must be first stated before the medical evidence in rape can be considered.

Degree of Penetration Necessary to Constitute Rape.—For the *legal* establishment of the crime, proof of penetration only is demanded (24 & 25 Vict. c. 100, s. 63). In a case of old date, *R.* v. *Russen*, it was held that a degree of penetration so slight as not to injure the hymen would be sufficient in law for the completion of the crime. In the case alluded to, the hymen of the child was proved to be entire, and, under the direction of the judge, the prisoner was convicted.

This trial took place in 1777; but Gurney, B., subsequently held that there must be a sufficient penetration of the male organ to rupture the hymen; and unless this membrane was found ruptured, the crime would not be complete in law (*R.* v. *Gammon*, Archbold, "Crim. Plea," p. 407). This decision was afterwards overruled by the judges, in a case reserved for their consideration by Coleridge, J., and reported in 9 Carrington & Payne (see also *R.* v. *Lines*, 1 Carrington & Kirwan's "Reports"). It is now, therefore, an admitted principle, that a sufficient degree of penetration to constitute rape in law may take place without necessarily rupturing the hymen; but in a special case there must be medical evidence to show that there was actual penetration—the degree of penetration being quite immaterial. It is true that there could not be a complete introduction of the adult male organ into the vagina of a child without rupture or laceration of the soft parts; but the absence of such marks of violence would not justify a medical witness in denying the perpetration of the crime, since the law does not require proof either of a complete or of a violent introduction. Penetration to the vulva is sufficient to constitute the crime.

In a case brought before a magistrate, the evidence left no doubt that the crime had been committed on the person of a girl about ten years old.

The surgeon stated that there were considerable marks of violence about the pudendum, but completion (*i.e.*, complete penetration) was, in his opinion, physically impossible on a child under ten years of age. Upon this evidence the charge of felony was abandoned.

In the following case the child was older, but the facts bear immediately upon the question which we are here discussing. It was tried at the Central Criminal Court in March, 1843 (*Lancet*, March 25th, 1843).

A man was charged with a rape upon his own child, a girl fourteen years of age. Adams examined the child about two days after the alleged rape, when he found no injury about the vulva or adjacent parts, and the hymen was unruptured. He gave a positive opinion at the trial that no rape had been committed; but two other medical witnesses, men of experience and integrity, stated their belief that the crime had been perpetrated. It appears that they had examined the child soon after the alleged offence, and a day or two before Adams. The prisoner was acquitted of the rape, but found guilty of the assault.

The absence of any marks of injury about the vulva so short a time after the alleged criminal act, and the fact of the hymen being unruptured, in some measure justified the opinion of Adams, that there was no medical proof of a rape having been committed; at the same time he candidly restricted his opinion, by saying, that if by rape we are to understand penetration to the vulva, then it was effected; but there was no evidence to show vaginal penetration—on the contrary, the unruptured state of the hymen in an alleged forcible intercourse was against this view. The only remark which this case requires is, that the statute laws say nothing about the rupture of the hymen as a necessary part of the evidence; it merely requires from the medical witness proof of penetration; this may occur, and the hymen remain intact. Vulval penetration, whether with or without violence, is as much a rape as vaginal penetration.

In Scotland this question came formally before the judges in the case of Macrae (High Court of Jus., 1841). It was insisted for the prisoner that there should be proof of full and complete penetration; and there was no sufficient evidence to show that penetration had taken place into the canal of the vagina beyond the vulva. Lord Meadowbank charged the jury to the effect that the evidence of the prisoner's guilt was complete; that scientific and anatomical distinctions as to where the vagina commenced were worthless in a charge of rape; and that by the law of Scotland it was enough if the woman's body was entered. In a case like this, where there was no evidence of emission, and the girl was young, he did not consider it necessary to show to what extent penetration of the parts had taken place,—or to prove that it had gone either past the hymen, into what was anatomically called the hymen, or even so far only as to touch the hymen. The prisoner was convicted (*Cormack's Edin. Jour.*, January, 1846, p. 48). Up to the date of the case of Macrae, it had been the practice with the Scotch judges to require proof of *full* and *complete* penetration. See on this question a paper by Easton (*Glasgow Med. Jour.*, July, 1859, p. 129).

It must be carefully noted that emission of semen is not mentioned at all, and therefore constitutes no part of rape, neither positively nor negatively.

AGE RELATIONS OF RAPE.

In the Male.—A boy under the age of *fourteen years* is presumed in law to be incapable of committing a rape (1 Hale, p. 631, and Mathew's "Digest," p. 57): but he can be convicted as a principal in the second degree if it be proved that he was present aiding and abetting the principal offender. In a case in which a boy of this age (fourteen) was charged with rape, the judge directed an acquittal. Although in other felonies sometimes *malitia supplet aetatem*, yet as to this particular act, the law presumes him to be impotent. Recorded cases, however, show that boys of this age are not always impotent. Instances of precocious puberty are, it is well known, very frequent. According to the statute law, proof of penetration only is required to complete the crime. As proof of emission is not necessary, it may become a technical question whether, admitting the existence of guilty knowledge, the crime might not be completed in law long before the signs of puberty were fully developed. This question is very likely to arise, where boys are charged with the crime of rape upon female infants. The proof of the fact must rest with the medical evidence. It is singular that the present English law of rape may, in strictness, be made to include male infants as well as adults. In *R.* v. *King* (York Wint. Ass., 1853), a boy aged fifteen was convicted of rape on a girl under ten years of age. In one case, a boy aged nineteen communicated syphilis to a girl six years of age. In India, Chevers states that a boy of thirteen or fourteen years of age was found guilty of rape. A lad of fourteen was convicted of rape on a girl of the same age: and in another case a boy only *ten years old* was convicted of rape on a girl three years of age ("Med. Jurispr. for India," p. 463).

In the Court for Crown Cases Reserved, February, 1893 (before

Lord Coleridge, Lord Chief Justice, Mr. Justice Hawkins, Mr. Justice Cave, Mr. Justice Day, and Mr. Justice Collins), *R.* v. *Williams* was thus considered and decided:—

"The question raised here, on a case reserved by Mr. Justice Vaughan Williams, was as to the conviction of a boy under fourteen indicted for an offence under Sect. 4 of the Criminal Law Amendment Act, for an indecent assault. The case stated that

> "Robert John Williams was indicted for having, at the parish of Holywell, on November 30th, 1891, feloniously, unlawfully, and carnally known a girl under the age of thirteen years—to wit, one Mary Hannah Jones, of the age of nine years. The case came to be tried before me at Mold at the Spring Assizes, 1892. It was suggested on behalf of the prisoner, that he was under fourteen years of age, and I, after hearing the evidence, put the question to the jury, who found that the prisoner was under fourteen. I directed the jury that the prisoner could not be convicted of the felony charged, or of an attempt to commit such felony. The prosecution insisted that under Sect. 9 of the Criminal Law Amendment Act, 1885, the prisoner was liable on the indictment for felony to be tried for indecent assault. I so held, and left the case to the jury, who found the prisoner guilty of indecent assault. I reserved this case on the question of law which arose at the trial, whether a male under the age of fourteen years, indicted for an offence under Sect. 4 of the Criminal Law Amendment Act, 1885, who by reason of his age cannot be tried or convicted for such offence, can, under the provisions of Sect. 9 of the said Act, be found guilty of an indecent assault, and I ordered the prisoner to be released on bail until this point should be decided, and the prisoner, having entered into his own recognisances to come up for judgment, and given the required bail, was released accordingly."

"No counsel appeared on either side.

"Their Lordships having read the case and conferred,

"Lord Coleridge delivered judgment, that the prisoner might rightly be convicted of an indecent assault, though he could not be convicted either of rape, or of an attempt to commit a rape, which he could not commit.

"Mr. Justice Hawkins agreed, though he said he did not quite concur in the opinion that a prisoner could not be convicted of an attempt to commit a crime which in law he could not commit. But here, upon the express enactment, the boy could be convicted of an indecent assault.

"The other judges concurred.

"Conviction for an indecent assault confirmed."

In the Female.—"*Any person who unlawfully and carnally knows any girl under the age of thirteen years shall be guilty of felony.*

"*Any person who attempts to have unlawful carnal knowledge of a girl under the age of thirteen years shall be guilty of a misdemeanour.*

"*Any person who unlawfully and carnally knows or attempts to know or have unlawful carnal knowledge of a girl above thirteen but under sixteen years of age shall be guilty of a misdemeanour*" (Criminal Law Amendment Act, 1885).

For determination of these ages and the medical evidence thereon, *vide* Vol. I., pp. 201 *et seq.*

It will thus be seen that under thirteen a girl is not presumed to be capable of either giving or withholding her consent. Above the age of thirteen but under sixteen consent is so far a mitigation of the offence as to reduce it from a felony to a misdemeanour, and even

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the offence itself without consent may be so considered. The law, however, in these cases gives the offender one more loophole, for it enacts :—

"*If it shall be made to appear to the court or jury before whom the charge shall be brought that the person so charged had reasonable cause to believe* [from appearance, manner, etc.] *that the girl was of or above the age of sixteen years,*" then consent shall be accepted as a good defence.

It must be remembered that when consent is of no avail as a defence even solicitation is equally unavailable.

Mental Condition of Victim in Rape.

"*Any person who unlawfully and carnally knows or attempts to have unlawful carnal knowledge of any female idiot or lunatic or imbecile woman or girl, under circumstances which do not amount to rape, but which prove that the offender knew at the time of the commission of the offence that the woman or girl was an idiot or imbecile, shall be guilty of a misdemeanour.*"

There is no specific mention of age here, but the insertion of the words "girl" and "woman" lead to a natural inference that the mental condition is only meant to be an additional safeguard against the crime, age being already sufficiently safeguarded.

Time for Bringing an Action.

In reference to the limit of age between thirteen and sixteen, it is expressly laid down :—

"*Provided that no prosecution shall be commenced for an offence under sub-section* 1 *of this section more than three months after the commission of the offence.*"

On this one has only to remark that with the exception of pregnancy or actual communicated disease, all signs of defloration are likely to have become completely obliterated, at least all really reliable signs (*vide* Sub-section B, pp. 29 *et seq.*), and even then they have nothing to do with consent.

It would be very reasonable to place this limitation of time upon all cases, irrespective of age.

Special Circumstances under which Rape may take, or be alleged to have taken, place.

1. **Under the Influence of Narcotics or Alcohol.**—If a woman be drunk or asleep from drink or other narcotic, the commission of an act of sexual intercourse without her consent is, of course, easily possible.

In *R.* v. *White* (Northampton Wint. Ass., 1856), the judge stated that some doubts were entertained whether the crime of rape could be committed (in law) on the person of a woman who had rendered herself perfectly insensible by drink, so as to be unable to make any resistance: he thought it could not be alleged as an excuse for the man. The question was not reserved, as the prisoner was acquitted of rape, and found guilty of an indecent assault (*R.* v. *Camplin*, *Law Times*, June 28th, 1845).

The editor is unable to find any special judicial ruling on the question of drunkenness and narcotics in rape, but there can be no question about the lessons that common sense would teach. If a woman (age is, of course, here not considered) alleges that she was first rendered unconscious by drink, and, furthermore, if she alleges that a soporific was administered in such drink, the first inquiry that springs to one's mind is—What was her previous character? why did she agree to have drink alone (such offences are not done in public) with a man? how much did she drink? what exactly happened after she had taken some drink?—*i.e.*, did she get more and more intoxicated with more drink, or did a condition of unconsciousness supervene on one drink only—how long was she alone with the man? All these points and others that would be sure to arise from her explanations require to be carefully considered before an opinion on the case can be arrived at. If it could be definitely proved that a known soporific, such as opium, had been used, there would be little doubt about a conviction; but if no unfair means had been used there can be equally little doubt but that a constructive consent had been given, however much it may have been regretted afterwards. The question (beyond the nature of the drug) is particularly one for a jury and common sense rather than for scientific evidence.

Dixon Mann ("For. Med.," p. 95) gives full details of a case where chloral hydrate was alleged to have been given for purposes of rape; the prisoner was awarded ten years' penal servitude, but was released at the end of two years on special representation to the Home Secretary.

2. **Under the Influence of Anæsthetics.**—The vapours of ether and chloroform have been criminally used in attempts at rape, although, by 48 & 49 Vict., the administration of any drug, matter, or thing to a girl or woman with intent to stupefy or overpower, so as thereby to enable any person to have unlawful carnal connection with such woman or girl, constitutes a misdemeanour.

In a case which occurred in France, a dentist was convicted of a rape upon a woman, to whom he had administered the vapour of ether. The prosecutrix was not perfectly unconscious, but she was rendered wholly unable to offer any resistance (*Med. Gaz.*, vol. 40, p. 865). A dentist was convicted of rape under somewhat similar circumstances in the United States, but it was thought that the woman had made the charge under some delusion. In *R.* v. *Snarey* (Winchester Lent Ass., 1859) there was a clear attempt at fraud. The prosecutrix asserted that she was *instantly* rendered insensible by the prisoner forcibly applying a handkerchief to her face, and she accused him of having committed a rape upon her. The charge was disproved by a distinct *alibi*, as well as by the improbability of all the circumstances. In *White* v. *Howarth* (Liverpool Wint. Ass., 1861) it was alleged that the defendant's daughter having gone to consult the plaintiff, who was a dentist, he took an opportunity of rendering her suddenly insensible by chloroform, and then had intercourse with her. In cross-examination, however, it transpired that the girl was not rendered insensible at all, but was conscious of all that was going on, and she might have given an alarm, but did not.

In *Bromwich* v. *Waters* (Chester Lent Ass., 1863) it was alleged on the part of the plaintiff that the defendant had given to a woman some liquid, which she had only tasted, and then suddenly became unconscious. It was suggested that while in this state the defendant had had intercourse with her, which he denied; the woman herself alleged that she was not conscious of her pregnancy until some months after this visit.

Most of these stories when properly examined will be found inconsistent and untrue. It is not the property of chloroform or of any narcotic substance, in a non-fatal dose, to render a person instantaneously insensible and powerless. If given in a non-fatal dose their effects are slowly and gradually produced; if they come on in a few minutes the dose must have been large, and then it is probable the person would die. There is no doubt that many of the charges made against medical men and dentists by women who allege that they have been violated whilst under the influence of anæsthetics are false charges. Anæsthetics stimulate the sexual functions, and the anogenital region is the last to give up its sensitiveness ("Bull. of the Medico-Legal Soc. of New York," May and December, 1881). These charges are sometimes made in all good faith by modest females. A woman under the partial influence of an anæsthetic may mistake the forcible attempts to restrain her movements, whilst she is passing through the preliminary stage of excitement induced by the anæsthetic, for an attempt upon her person. In one instance, a lady engaged to be married was accompanied to a dentist by her affianced husband. Chloroform was given, and a tooth extracted in the presence of this gentleman. She could hardly be convinced that the dentist had not made an attempt upon her chastity. Mann ("For. Med.," p. 93) mentions another similar case.

These are all cases in which the patient has voluntarily taken an anæsthetic for medical purposes; they inculcate the golden rule from which no exception should ever be made under any circumstances whatever, viz., **never administer an anæsthetic without the presence of at least one other person besides yourself and the patient**, and let, at least, one such person be disinterested. It is much easier for a charge of this sort to be brought forward than to be disproved, and especially so if there be a conspiracy of two to blackmail. (For hints on this subject, *vide* "Blackstone's Comm.," vol. 4, p. 213.)

On the other hand, the woman may not take the anæsthetic voluntarily, but may allege that she was anæsthetised (1) violently; or (2) while asleep. That a person can be anæsthetised without being awakened from a natural sleep is certainly possible, though in the many cases in which the experiment has been tried it has failed more frequently than it has succeeded; a statement, therefore, to this effect, when made by the victim of an alleged rape, should require a good deal of corroboration. That a woman may become paralysed, or may even faint, from fear, and subsequently be anæsthetised against her will, is also certainly possible; but when we are told that the throwing over the face of a handkerchief saturated with chloroform has produced instant unconsciousness under which rape has been carried out, the statement requires very careful consideration and close cross-examination as to fear, and what followed immediately upon the covering of the face; for that chloroform anæsthesia, or anæsthesia by any other known drug, can be thus instantly produced is an obvious—lie, no milder word is suitable. In cases such as these, signs of a struggle and consideration of the physical and moral and emotional character of the lady and gentleman respectively become the principal factors.

3. **Under the Influence of Fear or other Moral Restraint or Deception.**—Some medical jurists have argued that a rape cannot be perpetrated on an adult woman of good health and vigour; and they have treated all accusations made under these circumstances as false. Whether, on any criminal charge, a rape has been committed or not, is of course a question of fact for a jury and not for a medical witness. The fact of the crime having been actually perpetrated can be determined only from the evidence of the prosecutrix and of other witnesses; still a medical man may be able to point out to the court circumstances which might otherwise escape notice. Setting aside the cases of infants, idiots, lunatics, and weak and delicate or aged women, it does not appear probable that intercourse could be accomplished against the consent of a healthy adult, under conditions of fear alone, unless she fell into a state of syncope, from terror and exhaustion. An eminent judicial authority has suggested that, in his opinion, too great distrust is commonly shown in reference to the amount of resistance offered by women of undoubted character. Inability to resist from terror, or from an overpowering feeling of helplessness, as well as horror at her situation, may lead a woman to succumb to the force of a ravisher, without offering that degree of resistance which is generally expected from a woman so situated. As a result of long experience, he thinks that injustice is often done to respectable women by the doctrine that resistance was not continued long enough.

When several are combined against the female the case of course is rendered much more simple, and resistance may be impossible, but in this case we may expect to find some marks of violence on her person, if not on the genital organs.

A woman may yield to a ravisher, under threats of death or duress; in this case her consent does not excuse the crime, but this is rather a legal than a medical question. An aged woman can scarcely be expected to resist a strong man. Chevers mentions a case in which a man was convicted of rape and an aggravated assault on a woman of *seventy* years of age.

Recently two youths, each æt. 16, were tried for the rape of a girl æt. 14, but who appeared somewhat older (*R.* v. *Golding and Neal*, C. C. C., March, 1891). It was alleged that the girl was seized by the arms by Neal and held against some palings, whilst Golding had connection with her, she being in the standing posture. She then ran away; but was pursued and seized by the arms by Golding, whilst Neal now had connection, standing. The girl went home agitated, but made no complaint to her mother, who next day washed the girl's under-linen, but observed nothing unusual. When medically examined six days after the occurence, the vagina was dilated and inflamed, and the hymen ruptured and healed. The connection was not denied, the defence being that the girl, who had been sliding on the ice with the boys, was an inviting party. There was an acquittal on the charge of rape and a conviction for intercourse with a girl under sixteen years of age. It seems impossible for a youth to rape a girl whilst standing, since mere stooping, or bowing of the body, when held by the arms, would suffice to prevent penetration.

In 1899, a man was convicted of the murder of a woman, Sebra Troughear (*R.* v. *Kerr*, Carlisle Sum. Ass., 1899). From the evidence, it appeared that the woman died whilst, or shortly after, a rape was committed on her by the prisoner, accompanied with brutal violence. The actual cause of death was suffocation brought about by the vomiting of a hearty meal. The sentence was commuted, and in 1893 Kerr was liberated.

In connection with this case I am indebted to a distinguished Q.C. for the following legal memoranda:—

If a man in committing a rape, or in assaulting a woman so as to cause grievous bodily harm, causes her to vomit, whereby she is suffocated, he commits an act of constructive murder; but if the vomiting and death were the result of an attempt only at rape, he is guilty of manslaughter. If, on the other hand, the woman consented to have carnal intercourse, and all that the man did to her was the rude violence of a rough drunken man without intent to injure, he would have committed no offence whatever, even though what he did caused her to vomit, and thus led to her death from suffocation.

In the *Lancet*, vol. 1, 1902, p. 175, will be found an account of a case in which religious fervour was the lever used by a man to effect his purpose; the case known as the Horos case excited much indignation at the time; the man pleaded impotence, which was disproved.

At the June, 1904, sessions of the Central Criminal Court, in *R.* v. *McCarthy*, the prisoner was convicted of rape and sentenced to two years' hard labour under the following circumstances:—The prisoner advertised for girls for the stage, and under the pretence of teaching them to "do the splits" he had connection with at least two girls, æt. 19 and 23. The age and innocence of the victims were such as to call for the full penalty the law allows for the offence.

In all such cases the age and mental condition (innocence) of the girl are the principal factors in deciding upon the guilt of the prisoner. Medical evidence cannot go beyond its province of attempting to say whether or not connection has taken place.

4. **Can a Woman be Violated During Natural Sleep.**—It may be a question whether a man can have intercourse with a woman without her knowledge while in a state of *unconsciousness from natural sleep.*

Casper met with a solitary case in which a girl, æt. 16, accused a man of having had intercourse with her while she was sleeping in her bed. She asserted she was not conscious of his action until he was in the act of withdrawing from her. On her own statement she was *virgo intacta* up to the date of the occurrence. Upon the facts of the case, Casper came to the conclusion that, if her statement was true, the man could not have had intercourse with her without causing pain and rousing her to a consciousness of her position. The hymen was not destroyed, but presented laceration in two places. This and other facts showed that there had been intercourse, but did not prove that this had taken place without the consciousness of the woman ("Klin. Novellen," 1863, p. 31).

A man was charged with rape, and the prosecutrix swore that he had effected his purpose during her sleep. The bare possibility of the offence being perpetrated under these circumstances cannot be denied; but this admission could only apply to a case in which the woman had been accustomed to sexual intercourse, and in which the sleep was unnatural or lethargic. In this instance the woman was a prostitute, and the charge improbable.

A respectable married woman who had had children threw herself on her bed with her clothes on, late one evening, and fell fast asleep. She was first awakened by finding a man upon her body, in the act of withdrawing from her. This man, a servant in the house, was given into custody on a charge of rape. In the first instance he did not deny the act, and there was no reason to believe that the prosecutrix was aware of the prisoner's conduct until the crime was completed, and she was awakened in the manner described—apparently by the weight of the prisoner's body. The prisoner was convicted (*Edin. Month. Jour.*, December, 1862, p. 570).

A case which may serve to throw a little light upon this question occurred to Casper ("Gerichtl. Med.," vol. 2, p. 574). A married woman alleged that a man had had intercourse with her while in bed, and when she was asleep. In her deposition, however, she admitted she was conscious that some one was lying upon her, and that she asked who it was, showing, as Casper remarks, that she had a knowledge of what was going on, and a *doubt* whether the person was her husband.

In reference to the question whether it is possible to commit rape upon a woman while asleep, a majority of the Scotch judges decided, in the case of Sweenie ("Irvine's Justic. Rep.," vol. 3, p. 109), that the feloniously having connection with a woman while asleep was not indictable under the name of rape, inasmuch as, apart from the force implied in the act of connection, there was no force used to overcome the will of the woman. But they held, however improbable it might be, it was quite possible that a man might have connection with a woman while asleep (*Edin. Month. Jour.*, December, 1862, p. 570), forgetting, possibly, "*non omnes dormiunt quæ clausos habent oculos.*"

The state of the mind during the act of **waking from natural sleep,** *i.e.*, when a person is in a half-conscious state, may also give rise to a question connected with rape. In *R.* v. *Clarke* (York Aut. Ass., 1854) the prisoner was charged with having committed a rape on the prosecutrix.

The woman had been married to her husband six years, and had had three children. Prisoner took advantage of his absence from home to get into the bed of the prosecutrix, about two o'clock in the morning: she mistook him for her husband and under this mistake allowed him to have intercourse with her. It was only some time afterwards that she found it was the prisoner, and not her husband, who was in bed with her. The jury convicted him on this evidence.

The case was reserved by Crowder, J., for the opinion of the judges whether the offence amounted to rape, as it was not included in the ordinary definition, *i.e.*, of carnal knowledge by force and against the will of the woman. In *R.* v. *Rickstraw* (C. C. C., 1863), and *R.* v. *Jackson*, in both of which intercourse had been had with women under similar circumstances, it was held that the offence did not in law amount to the crime of rape. In the former case, the prisoner was tried and found guilty of an unlawful assault on the prosecutrix. Keating, J., then stated, that where a man personated the husband, the act of intercourse did not amount to rape, because it was done with the assent of the woman (but *vide* below, now expressly ruled as rape). The prisoner, in his defence, stated that the intercourse had taken place by the woman's consent, and that she had invited him; but this she denied, and the circumstantial evidence in the opinion of the court tended to negative the prisoner's statement: he was convicted of an assault. It is a curious psychological question, however, whether a woman can have connection, under these circumstances, without at least entertaining a suspicion that the man is *not* her husband. It is a matter of great doubt, when intercourse has thus been had in a waking state, whether the act could take place without the tacit assent of the woman.

5. **Can a Woman be Violated during Hypnotic Sleep.**—The condition of the so-called *hypnotic* or unnatural sleep has given rise to a question connected with the alleged perpetration of rape.

A girl, æt. 18, consulted a therapeutic magnetizer as to her health. She visited him daily for some days. Four and a half months afterwards she discovered that she was pregnant, and made a complaint to the authorities against the magnetizer. They directed a physician and surgeon to determine the date of her pregnancy, and whether complainant might have then been violated and rendered pregnant contrary to her will, *i.e.*, if her volition could have been completely or partially annihilated by magnetism. The medical inspectors were satisfied that the pregnancy did not extend farther back than four and a half months; and founding their opinion on Husson's report, made to the Academy in 1831, concluded that, as a person in magnetic sleep is insensible to every kind of torture, sexual intercourse might then take place with a young woman without the participation of her will, and without her being conscious of the act, and consequently without her being able to resist the act consummated on her. The opinion was confirmed by that of Devergie (*Gaz. Méd. de Paris;* and *Edin. Month. Jour.*, December, 1860, p. 566).

Ladame recognises the possibility of the violation of a female whilst in a state known as hypnotism, or animal magnetism; and gives a detailed account of a case in which it was alleged that not only was a female violated against her will, whilst in that state, but that conception took place ("Ann. d'Hyg.," 1882, 7, p. 518). The case is not, however, one that is free from grave doubts as to its being a veritable case of rape.

Although the editor is unable to find any recently recorded case of this kind, there can be no reasonable doubt about the possibility of such an occurrence, and this is one of the reasons why this method of therapeutics is looked upon with some disfavour and as one requiring great care in its practitioners.

6. **It is Rape if the Ravisher Personates the Husband.**—This statement is expressly made by 48 & 49 Vict. c. 69, par. 4, at the end.

In the case of *R.* v. *Morrissey* (C. C. C., July, 1892), the prisoner was awarded three years' penal servitude on conviction of rape on a married woman under the following circumstances. He entered the woman's room when she was alone in bed and asleep. She awoke as the prisoner was finishing sexual connection with her, thinking it was her husband. Pollock, B., in leaving the case to the jury, said that a man having connection with a sleeping woman, by personating her husband, *i.e.*, putting himself in such a position that she might suppose him to be her husband, would be guilty of rape.

This case illustrates very well the difficulties of these cases, which really turn on the credibility of witnesses, a point certainly not so well within reach of those who only read the evidence in print. The evidence of the prisoner and prosecutrix is, the editor thinks, worth giving in full, for in his opinion cases of "impersonation of the husband" are even fuller of suspicion than those "during sleep."

The statement of the prosecutrix was to the effect that the prisoner had lodged in the house nine or ten months, that he was a horsekeeper, that her husband was usually out with his cab till midnight or later, that on the night of the 12th June she had gone to bed about half-past ten and was asleep, that she was awoke by finding the prisoner in her bed in the act of having connection with her. Thinking it was her husband, she called "Sam," her husband's name, upon which the prisoner made some remark, and, finding it was not her husband's voice, she screamed and threw him off, got out of bed, and ordered him out of the house, saying, "Jim, how dare you come into my bed?" He said, "What is the matter, mistress? I will go on my knees to you for pardon." "I said, 'I want no pardon for this.' He ran into his own room and dressed himself. I followed him into the kitchen and ordered him out of the house, and he went out. My husband had gone away into Suffolk on the Saturday to his brother's funeral. In the morning I wrote to him and he came home, and on the 15th I applied for a warrant against the prisoner."

The prisoner cross-examined the prosecutrix, and was then sworn and gave the following evidence: "When I went home the woman used to kiss me every other night after I had done my work. When I went upstairs her door was wide open. I went into her room and woke her up, and she shifted over in the bed. I got into bed with her. I was undressed; she catched hold of my person, and put it in. She never said a cross word, not until I had finished, then she shouted out, 'What are you doing in my bed, Jim?' so I got out of her bed and went into my own in the next room. I dressed myself and went down into the kitchen. She followed me down, gave me two boxes on the nose, and turned me out of doors."

Cross-examined: "I was not drunk or sober, I was half and half. She used to kiss me at night when I came home. I went into my own room and undressed before I went into her room. I caught hold of her and said, 'Wake up, Jonnie,' and she moved over in the bed. The first thing she said was, 'My God! is that you, Jim?' I said 'Yes, mistress,' and she said, 'What are you doing in my bed?' She was very angry."

By the Court: "When she kissed me her husband was not at home. I had never taken liberties with her before."

The prosecutrix was recalled and stated: "I never kissed the prisoner. He had tried to kiss me some time ago, about twice; it was in my husband's presence. He thought it was only chaff, as we were saying good-night, and going up to bed. My bedroom door was not open on this night; I always close it. I don't know whether the prisoner had been drinking, he was a fairly sober man."

7. **Influence of Hysteria.**—In *R.* v. *Baker* (C. C. C., September, 1872), the prosecutrix, æt. 17, alleged that she did not consent to the act, and evidence was given to show that she had been suffering from *hysteria* and was in a fit at the time that the act was perpetrated. The prisoner was convicted. Cases in which hysteria is pleaded as the cause of unconsciousness should be regarded with great suspicion. It is easy for a girl who has given her consent and repented, to make a plea of this kind. A medical man is bound to see in these cases whether there is any evidence of force or marks of violence on the person or genitals.

8. **Rape on Prostitutes.**—It must be remembered that the law protects a prostitute against involuntary connection just as it protects children and chaste women, but when a charge of rape is made by a prostitute, it is justly received with suspicion, and the case is narrowly scrutinised. Something more than medical evidence would be required to establish a charge under these circumstances. The question turns here, as in all cases of rape upon adult women, on the fact of *consent* having been previously given or not. This is the point at which the greater number of these cases of alleged rape break down; and it need hardly be observed, that this question has no relation to the duties of a medical witness; all that he can do is to establish, occasionally,

whether or not sexual intercourse has been had with or without some violence. It is obvious that there may be marks of violence about the pudendum or on the person, and yet the conduct of the woman may have been such as to imply consent on her part; we must not suppose that medical proof of intercourse is tantamount to legal proof of rape.

MEDICAL ASPECTS OF RAPE.

Medical evidence is commonly required to support a charge of rape, but it is seldom more than corroborative; the facts are, in general, sufficiently apparent from the statement of the prosecutrix. There is, however, one case in which medical evidence is of some importance—namely, when a false accusation is made. In some instances, as in respect to rape on infants and children, the charge may be founded on mistake; but in others there is little doubt that it is often wilfully and designedly made, for motives into which it is here unnecessary to inquire. Amos remarked, that for one real rape tried on the Circuits in his time, there were on the average twelve pretended cases. In some few instances these false charges are at once set aside by medical evidence—in others, medical men may be sometimes the dupes of designing persons; but in the majority, the falsehood of the charge is proved by inconsistencies in the statement of the prosecutrix herself. It is stated that in Scotland, where there is a careful preliminary inquiry, false charges of rape are exceedingly rare.

The duty of a medical witness on these occasions will be best understood by considering the subject in relation to females at different ages. On being called to examine a person on whom a rape is alleged to have been committed, the first circumstance which a practitioner should notice is the precise *time* and date at which he is summoned, taking an early opportunity of comparing his watch with some neighbouring clock. This may appear a trivial matter, and one wholly irrelevant to the duties of a medical practitioner; but it is to be observed, that the time at which a surgeon is required to examine a prosecutrix may form a material part of the subsequent inquiry. It will be important to the defence of a person accused, if it can be proved that the female did not take the earliest opportunity to complain; and it may also be the means of defeating an alibi falsely set up by an accused person in his defence.

It is rare that cases of rape are tried without medical evidence; occasionally an attempt is made to dispense with it, and the result is generally an acquittal. Juries naturally dislike to convict persons of this serious crime, unless the statement of the prosecutrix is corroborated by medical facts and opinions (*R.* v. *Walker*, Maidstone Wint. Ass., December, 1862). Medical evidence in cases of rape may be derived from four sources: (1) Marks of violence about the genitals. (2) Marks of violence on the person of the prosecutrix or prisoner. (3) The presence of stains of the spermatic fluid, or of blood, on the clothes of the prosecutrix or prisoner. (4) The existence of gonorrhœa or syphilis in one or both. This evidence will vary according to circumstances.

In examining the victim of alleged rape it is important to remember that no one, neither coroner, magistrate nor judge, nor any police official, can *compel* a girl to submit to being examined without being guilty of, and running the risk of an action for, indecent assault; hence there are three people whose consent must be obtained before undertaking such an examination (*vide* Vol. I., pp. 65 *et seq.*). These three are :

1. **Yourself.**—Let your conscience be clear that you have reasonable grounds to wish, or even to press, for an examination, so that, if it should be necessary, you can give substantial grounds for your action, carrying with them the probabilities of consent.

2. **The Victim.**—If of reasonable age and understanding to give consent.

3. **The Nearest Guardian.**—This is essential if the victim is not of reasonable age and understanding, and is certainly advisable in all cases.

If the circumstances are in any way peculiar, it is advisable to have the consent in writing, and in all cases, without exception, a verbal consent should be given *in the presence of disinterested witnesses.* It is also necessary to state openly that evidence derived from such examination may be used against as well as for the examinee ; this is particularly the case in examining suspected persons.

Having obtained these consents, proceed in a good light and in a position which allows of a most thorough examination by eye, finger, and instruments if necessary, to make your investigations.

Previously to the actual inspection of the genitalia it is well that you should make written notes on the following points.

1. Date and exact hour at which she visits you.	1. Required principally in reference to lapse of time since the occurrence, if long delayed, why?
2. Her walk or attitude, bodily and mental.	2. As to pain on walking, excited or otherwise, under the influence of alcohol, etc. Physical and emotional constitution.
3. Who is with her, and their attitude and frame of mind towards victim and accused.	3. Refers to concocted or genuine tales ; chances of conference as to what to say, etc.
4. The statements of her and of her friends, inquire especially : (*a*) Age. (*b*) Date, time and place of alleged offence. (*c*) Exact position of the parties, sitting, lying, or standing, etc. (*d*) Did she cry out or not, or struggle ? (*e*) Menstruating or not at the time ? (*f*) Was she sensible the whole time ?	4. These must be taken down as near as possible verbatim, and will constitute most important evidence either to establish guilt or to free the innocent. She and her friends have probably been to others, or made statements to others, and the general or special agreement of the various statements will be strong proof of their truth or of their falsehood.

Then have her completely undressed, and with regard to her clothes note more especially—

(*a*) Blood on them, and its situation.	All obviously very important, corroborating or contradicting the notes you have made of her tale.
(*b*) Mud and other stains, grass, etc.	
(*c*) Seminal stains, or what look like them, on the drawers, chemise, etc.	

And with regard to herself, note the physical development of the limbs, for powers of struggling, etc., and bruises and injuries found on the body generally, and inquire (and note her explanation) how they came there, especially with reference to the possibility of their self-infliction, or to their consonance with her tale.

Then proceed to examine carefully the genitalia, including the breasts. It may occasionally happen that the girl is menstruating, or alleged to be so. In clinical practice it is usual at this time to avoid a vaginal examination from motives of decency, but in criminal cases this objection cannot hold; in fact, the establishment of the fact of menstruation may be a most natural point, as in the following case reported to the editor by Dr. Lowndes, of Liverpool.

> I had to examine a girl, aged fifteen, who was said to have been outraged. I asked her mother if she had begun to be "poorly," and she said no, but that she had bled much from the outrage. On examination I found blood on the privates and thighs, while the drawers and shift were soaked with blood, and this was three days after the assault. It was clear that the girl had begun to menstruate.

(*a*) Breasts.	(*a*) In masturbators frequently flabby and large, a point not of great weight, but worth noting.
(*b*) Vulva.	(*b*) Swelling, redness, bruises, tears, tenderness, etc., are all important points that want explanation of their origin, but don't at once jump to the conclusion that her explanation is necessarily the correct one, it may or may not be so.
(*c*) Vagina.	(*c*) Discharge from it, ulcers or growths in its mucous membrane, etc. A purulent discharge can hardly arise within twenty-four hours of connection; nor can a venereal sore of any sort appear suddenly.
(*d*) Hairs on pubes.	(*d*) May be evidence of age, but particularly look for a matting together of them; examine the cause of the matting, (removing some hair for the purpose) under the microscope or chemically for semen, pus, blood, etc. (*vide* Vol. I., pp. 144 *et seq*.).

This represents a complete scheme for the examination of the female. The deductions to be drawn depend very much upon circumstances, of which the most important is the time that has elapsed since the alleged offence : they may vary from completely negative through the doubtful, up to those carrying conclusive conviction that some violence has been offered to the parts, and (with semen in the vagina) possibly proving that it was a penis that produced them ; though even this has nothing *per se* to do with consent, the absence of which is the crux of the position.

If in the power of the medical jurist it is well that the accused should be examined on a similar plan.

1. Age, size, and strength.	1. The proportion these bear to those of the victim in connection with fear, power to struggle, physical possibility of connection, etc.
2. Scratches and bruises.	2. Evidence of an alleged struggle, or against such.
3. Stains on linen.	3. Seminal or other, possibly quite capable of innocent explanation.
4. Condition of organs.	
(*a*) Impotency.	(*a*) *Vide* pp. 3 *et seq.*
(*b*) Smegma on prepuce.	(*b*) Its presence renders recent copulation very improbable.
(*c*) Gonorrhœa.	
(*d*) Venereal sores.	
(*e*) Matting of hairs, etc.	

It must be noted that all these points, even if positive, are quite capable of innocent explanation, for copulation is not illegal, nor is masturbation, but they must be carefully noted for the same purposes as the statements of the victim—viz., to corroborate or contradict statements made.

Lastly, examine the site of the alleged offence, if you think it necessary, wet or dry, grass or bare ground, etc., etc.

It now remains to consider with illustrative cases the conditions under which rape occurs.

RAPE ON INFANTS AND CHILDREN UP TO THE AGE OF SIXTEEN.

It is in this group of cases that medical evidence is of the greatest importance, because consent cannot be considered.

To the great opprobrium of our boasted civilisation this crime is of very frequent occurrence, sometimes, no doubt, as the result of simple lust ; but often indeed from a still more disgusting reason, for there is a vulgar error that gonorrhœa, and even syphilis, can be cured by sexual intercourse with a virgin ; the editor has reason to believe that this horrible superstition is still rife, though it is almost impossible to conceive how it can have arisen.

The sexual organs should in these cases present **marks of injury** if the crime has been completed, and there has been *any resistance on the part of the child :* for it is impossible to conceive that forcible intercourse should take place without the production of bruising, the effusion of blood, or a laceration of the private parts. Even without reference to manual violence on the part of the assailant, the size of the adult male organ must necessarily cause much local injury in the attempt to enter the vagina of a child. If the violation has taken place within two or three days, the appearances presented by the parts may be as follows:—1. Inflammation with more or less abrasion of the lining-membrane of the vagina, or the entrance. 2. A mucopurulent discharge from the vagina, of a ropy consistency and of a yellowish or greenish-yellow colour, staining and stiffening the linen worn by the girl; the mucous membrane of the urethra is inflamed, rendering the discharge of urine painful. 3. In recent cases blood may be oozing from the abraded membrane, or clots of blood may be found deposited in the vulva. 4. The hymen may be entirely destroyed, or (what is more commonly observed) it may present on careful examination one or more lacerations. Owing to the inflamed state of the parts, the proper examination of the hymen is rendered difficult—any attempt to separate the thighs for this purpose causing great pain. For this reason, also, the child walks with difficulty and complains of pain in walking. 5. Lastly, the vagina may be unnaturally dilated.

The case of *R.* v. *Peter Murray* is a very good illustrative case of clearly proved rape on a young girl, the motive being the execrable superstition alluded to above.

On March 2nd, 1884, a girl aged fourteen, A. C., was admitted into the Liverpool Lock Hospital, and was examined on her admission by Lowndes, who found her suffering from constitutional syphilis. She walked with the peculiar gait indicative of pain in the genitals. The hymen was found to have been ruptured some time previously, the two longitudinal folds remaining. There were primary syphilitic ulcers of the external vulva, also condylomata extending from them to the anus. There was a well-marked roseola over the body, and the peculiar state of the throat which accompanies condylomata of the genitals or anus.

In answer to questions, she stated that a man, whom she named, had had forcible connection with her the Saturday before the previous Christmas (December 22nd, 1883). This very fairly corresponded with her symptoms, remembering that she had received no medical treatment. The prisoner was arrested on the following day and brought by the police to Lowndes, who, after obtaining his consent and duly cautioning him as to the result, examined him. He found a well-marked indurated chancre, all but healed, and condylomata ani; the man was in a very dirty and most offensive state. He was charged with rape and committed for trial. The girl's story was that she remembered the day as the one when her mother went to the pawnbroker's to redeem a lamp she had pledged. This was corroborated by the mother and pawnbroker's assistant. Her parents were both of drunken habits, and it was evident that the prisoner, who knew their habits well, had watched them go out. He sent a younger sister of his victim for beer, and another one for apples, then, locking the door, threw the girl upon the floor and committed the offence. The girl's story was corroborated in every particular, while an elder sister, who was a prostitute, gave important evidence as to the motive. The prisoner made overtures to her some time after, and as his diseased condition was well known, she asked him if he was cured. He answered that he had cured himself by connection with a young girl, adding, "You would be astonished if you knew who." He was found guilty.

It has been questioned whether a rape can be perpetrated on children of tender age by an adult man; and medical witnesses at trials have given conflicting opinions. Some are inclined to regard all such charges as unfounded, and to seek for other medical explanations of the symptoms above described. This practice has been carried to an undue extent, simply because many of these charges have been proved to be false; but common experience shows that there is too frequently a real foundation for the charge in reference to children, and that a girl is not to be discredited merely because of her tender age. This would be conferring impunity on the acts of a vile class of offenders. In all cases there should be good medical evidence and a corroboration from circumstances.

Sometimes the Violence is extreme.—Sir Thos. Stevenson gave evidence in a case where the peritoneum was penetrated, and the parts about the vagina extensively lacerated (*R.* v. *Wood*, Lewes Ass., January, 1892).

It is difficult to obtain accurate medical reports of these cases as they occur in England; but it is clear that the male organ may produce much physical injury whether the child does or does not resist the attempt.

The following cases show also what extensive injuries may be inflicted. The editor is mainly indebted to Dr. Lowndes for them.

R. v. *Crowley*, Liverpool Ass., 1895:—The prisoner, Michael Crowley, aged twenty-four, was tried before Hawkins, J., at Liverpool, on the 11th May, 1895, for a criminal assault on his daughter Catherine, who was at the time a little under four years old. From the evidence given it appeared that on Saturday, the 20th April (just three weeks before the trial), the prisoner, who admitted having had nine or ten pints of beer that afternoon, was left with the child about 6 o'clock in the evening, the mother going out for a little while. On her return she noticed that the child's eyes were blackened, and asked the prisoner what he had been doing. He made a remark that it was not her eyes but that she was "bleeding below." The mother then saw that the child was naked, and that her privates were torn and bleeding. She charged the prisoner with having done it, and threatening to inform the police, wrapped the child up in her apron and took her to the Northern Hospital. The child was examined by Byers, resident surgeon, who found the following appearances:—

Patient was a very well-developed child, rather large for its age. There was ecchymosis about each eye, and several slight bruises on the body of the child.

The Perineum.—The labia majora were swollen and bruised, the right especially so. The fourchette had been torn across, as well as the posterior wall of the vagina, for a depth of rather over a quarter of an inch. Extending backwards from this there was a deep laceration which came up to the anterior wall of the rectum (this last structure was intact); the anterior part of the external sphincter, *i.e.*, that part between the anal orifice and the central tendon of the perineum, had been torn. On admission there was only slight oozing of blood.

The child was anæsthetised and the laceration, after careful cleansing, was closed with four deep sutures of silk-worm gut. The child was discharged cured, 9th June.

The prisoner went off to the nearest bridewell and told the officer of what his wife had accused him. He was detained at the bridewell while inquiries were made, and as a bucket containing bloody water was found at his house, and the condition of the child had been ascertained, he was taken to the detective office. He expressed a wish to be examined by a doctor, and was examined by Lowndes, police surgeon, who first obtained the prisoner's consent, in the presence of witnesses, and cautioned him as to what the result of the examination might be. He consented and undressed. There were no marks of violence on his person, nor any stains of blood, semen, etc. It was observed by Lowndes and the detectives present that his pudenda were unusually clean for a man of his employment, and cleaner than the rest of his body. He had had time and opportunity to wash himself. He was charged with having carnal knowledge of his daughter, and in reply, said, "I know nothing whatever about it." The apron in which the child had been wrapped when she was taken to the hospital was sent to Davies, who found blood and spermatozoa on the apron on one spot, and blood only on the other. There was nothing found elsewhere. The clothes had been washed and left wet, until they smelled horribly and swarmed with microscopic organisms, and the water in the bucket had been thrown away.

At the police court, and subsequently at his trial, the prisoner elected to be sworn and examined. He stated that he was washing the child in the bucket (an ordinary wooden one) when she slipped from his hands and fell astraddle of the bucket, the injuries being caused in this way. With the permission of the honorary surgeon, Wilson, Lowndes was permitted to see the child in the hospital, and was thus able to confirm Byers' evidence. Both expressed the opinion that it was impossible that the injuries could have been caused in the manner described by the prisoner. The child was, of course, unable to give evidence on oath, being mentally rather backward though a bright-looking child. She told her mother that "daddy had done bad in the bucket," but this could not be given in evidence. The mother was (in accordance with the provisions of the Criminal Law Amendment Act, 1885) a willing witness against her husband, her evidence being corroborated by a neighbour. The jury wished to know why no marks of violence were found on the prisoner, to which Lowndes replied that the male organ, being pressed against soft parts, would not show marks of violence. In reply to another question he repeated his strong conviction that the injury to the child could not have been caused in the manner described by the prisoner. He was convicted and sentenced to ten years' penal servitude, the judge remarking that he did not believe that the prisoner intended to do what he did, but that it was the consequence of his drunken habits.

Colles reported a case in which a rape was committed by an adult on a child eight years old; it terminated fatally from peritonitis, as a result of the violence, six days after the assault. The child stated that the accused had had forcible connection with her, causing much pain and loss of blood. There were no marks of violence (bruises?) externally, but the orifice of the vagina was lacerated in its entire circumference, and the perineum was nearly torn through. It was found, on inspection, that the orifice, as well as the whole of the vagina, was in a state of gangrene, and that its posterior wall had been lacerated at its line of junction with the uterus to the extent of an inch. There was no ulceration; the labia and clitoris had not undergone any change (*Med. Times and Gaz.*, 1860, 1, p. 560). The prisoner subsequently confessed his guilt.

A case was communicated to the *Glasgow Med. Jour.* (July, 1859), p. 140), which proves that extensive injuries may be produced on a child by the act of violation. The girl in this instance was about six years of age, and very intelligent. From her description of the assault, it appears that she fainted, probably owing to the severity of the pain. When examined, it was found that the vagina was ruptured in various directions. One laceration extended from the lower part downwards, dividing the recto-vaginal septum and perineum down to the verge of the anus. There was a lacerated opening in the coats of the rectum; the orifice of the vagina was lacerated upwards as well as laterally; the parts were raw, swollen, and very tender. When the child was first seen there was blood on the limbs and clothes; she recovered from these serious injuries in about two months.

In reference to the case of Amos Greenwood, it was a question raised in favour of the prisoner, whether rupture of the perineum could or could not be effected in rape on a girl. Some eminent members of the profession appear to have doubted the possibility of rupture being produced under these circumstances (see *Dub. Med. Jour.*, February, 1859, p. 51), but the facts here recorded show that it may occur.

In 1840, Brady communicated a case of alleged rape on a female infant only eleven months old, in which the violence done to the genitals proved fatal. During the march of a regiment, the prisoner, a soldier, who was with the sick car, took the child from its mother to carry it some way for her. The child was quite well when he took it: he walked on quickly, and was out of the mother's sight in half an hour. When she came up, he had the child standing on the grass facing him, and he was bent over it: with one hand he held the child's petticoats up, and the other was covered with blood. He told the mother that the child was ill and passing blood. The mother rolled it in her shawl, and carried it to an apothecary; but no examination was then made, and it was not until the next morning that, in washing the child, the marks of violence were seen. This was the substance of the mother's evidence, which was uncontradicted at the trial. A surgeon examined the child twenty hours after the alleged outrage: it was then in a state of collapse, and it died in a few hours. All the external parts of generation were found in a torn state, and violently inflamed; the perineum was torn nearly through; the nymphæ and the mucous lining of the labia and clitoris were likewise lacerated, so that the whole presented the appearance of a large lacerated wound in a high state of inflammation. After death, besides the above-mentioned appearances, the vagina was found greatly dilated and torn from its attachment to the neck of the womb posteriorly, making a large opening into the cavity of the abdomen, in which a quantity of bloody serum was effused (*Med. Gaz.*, vol. 26, p. 160). Wilde, on making inquiry into the particulars of this case, ascertained that there was no proof of the actual perpetration of rape. The severe injuries to the genital organs which led to death were produced, it was alleged, by the fingers—the man being at the time partially intoxicated (*Dublin Quart. Jour. of Med. Sc.*, February, 1859, p. 51).

In 1858, a girl, seven years old, was brought into Guy's Hospital, owing to injuries resulting from a perpetration of rape by a boy under seventeen years of age. About half an hour had elapsed when she was examined, there was found a complete destruction of the hymen, with a laceration of about one-eighth of an inch extending into the perineum. There had been profuse bleeding, as the clothes were saturated with blood. There was then no complaint of pain, and there were no scratches or marks of violence on any part of the body. There was no discharge of a purulent kind. The child was of a scrofulous habit; but she was not suffering from vaginitis, and appeared in other respects perfectly healthy. Forty-eight hours after the occurrence the bleeding had ceased, and the extent of the lacerations were very perceptible. There was no discharge of any kind from the vagina, and no inflamed or swollen condition of the parts. The boy was examined about an hour after the perpetration of the rape, and although he had been under strict custody, and had had no opportunity of changing his clothes, there was *no blood* found about his private parts, or on his clothing. It is probable, as the boy was interrupted in the act by the screaming of the girl, that he suddenly withdrew after having caused the laceration, and that the bleeding was an after-effect of oozing from the ruptured vessels.

This **absence of blood on the accused** is important, because the main facts of the case were indisputable; such absence of blood might be construed into evidence of innocence. It is clear from the above case and the two following that such an inference is quite unjustifiable.

Sawyer met with a case in which a rape was committed on a girl æt. 5. There was a bruised and swollen state of the genitals; the hymen was not ruptured, and there was no laceration of parts. In spite of this, a large amount of blood had been lost. This bleeding, he considers, took place from the hymen, which was in a highly congested state. The man who had perpetrated the crime was examined soon afterwards, but no appearance of blood was found on his organs; there were a few stains only on the front of his clothing (*New Orleans Med. Gaz.*, 1858, p. 283). A case occurred to Sells, in 1863, in which he found on examining the person of a girl said to have been violated, laceration of the hymen, a clot of blood recently effused lying on the vulva, and the thighs of the child smeared with blood, quite fresh; there was also blood on the sheets of the child's bed. The next morning he examined the accused, but he could find no trace of blood upon him or on the clothing which he wore at the time of the alleged assault. In this case, as there was a failure of identity, the accused was discharged.

The following case is also interesting on account of the seminal evidence:—

Assizes, 24th November, 1893, before Mr. Justice Day, Samuel Lewis Chambers, 20, was convicted of attempting to carnally know Kate O'Hanlon, æt. 4½, and was sentenced to 20 months' imprisonment with hard labour. There was evidence of slight penetration and seminal fluid was found on her thigh, her boot (right), and her drawers.

If no Marks of Violence are Found.—When there are no marks of violence or physical injury about the pudendum of a child, whether because none originally existed, or they existed and had disappeared in the course of time, a medical witness must leave the proof of rape to others. He can only answer questions of possibility, or probability, according to the special facts proved. It is, however, in all cases his duty to be guarded in giving an opinion that a rape has been perpetrated, when there is a total absence of marks of violence on the genitals. It is true that rape, in a legal sense, may be perpetrated without necessarily producing such marks on a child, but then the proof of the crime will not depend on *medical evidence* only. The absence of marks of violence on the genitals, when an early examination has been made, furnishes a strong presumption that rape has *not* been committed on these young persons. It is obvious that a false charge might be easily made and sustained, if medical opinions were hastily given on the statements of a mother and child when there was no physical appearance to corroborate the accusation. (See a paper by Toulmouche, "Ann. d'Hyg.," 1864, 2, p. 338.)

Violence Found, but its Origin Possibly Doubtful.—In the cases hitherto narrated the child has been examined within a very short time of the alleged offence, when, with the account of the assault still in the ears of the medical man, his task is a comparatively easy one to say that violence has been inflicted, and that probably by penis or finger, but such marks must not always be hastily assumed to furnish proofs of rape; for cases are recorded in which such injuries have been purposely produced on young children, as a foundation for false charges against persons with a view of extorting money. The proof or disproof of facts of this kind must rest more upon general than on medical evidence, unless the injuries obviously indicate the use of some weapon or instrument. It should be remembered that the hymen is not always present in young children; it may be, according to some, congenitally deficient, or, what is more probable, it may have been destroyed by ulceration or suppurative inflammation of the parts—a disease to which female infants of a weakly habit are subject. The absence of this membrane, therefore, can afford no proof of the perpetration of the crime, unless we find traces of its having been recently torn by violence.

Chevers states, on the authority of a missionary well acquainted with the habits of the natives of Calcutta, that **mechanical means** are commonly employed, even by the parents of immature girls, to render them *aptæ viris*, especially by the use of the fruit of the plantain. In one instance a man was convicted of rape who, according to the evidence, had previously used a small stick—*ad deobstruendam viam*. This led to effusion of blood, but to no permanent injury. It is scarcely credible that mothers should resort to such practices, nevertheless the facts are too well accredited to admit of denial. Casper examined a girl only ten years of age, whose vagina had been dilated by the mother, at first with two fingers, afterwards with four, and finally by means of a long stone introduced into it, in order to fit her for intercourse with men. The hymen was not destroyed, but there were lacerations in it; the mucous membrane was reddened and painful to the touch, and there was a mucous discharge from it (" Gerichtl. Med.," vol. 2, p. 162). A fact like this proves that medical evidence can do no more than show that a girl with such appearances about her sexual organs has suffered from some mechanical violence applied to the part, but whether by the human member, or any other physical means, it would be impossible to say.

If, moreover, there has been considerable delay before inspection, inflammation, followed by sloughing or mortification, may have set in, and such may destroy life, especially in children of an unhealthy habit. Care should be taken that the symptoms of a malignant form of disease (noma, a form of destructive ulceration), to which female children are sometimes subject, are not mistaken for criminal violence. The case of Amos Greenwood (Liverpool Wint. Ass., 1857) is of some interest in this respect. The prisoner was convicted of the manslaughter of a female child under ten years of age, as the result of injuries produced by a criminal assault. The main facts against the prisoner were considered by the court and jury to be clearly proved; he was convicted. The propriety of this conviction was questioned by Wilde (*Dub. Quart. Jour. of Med. Sci.*, February, 1859, p. 51). It would be impossible in this place to give an analysis of the conflicting statements and counter-statements which have been made respecting Greenwood's case; but there is no reason to doubt that the prisoner was accessory to the death of the child. A member of the Northern Circuit, who took no part in the case, but was present and heard the whole of the evidence, informed the author that it was satisfactorily proved that violence had been done to the genital organs, and in the general opinion of the bar the man was rightly convicted. The reader will find the evidence fully discussed in the *Med. Times and Gaz.*, 1859, 1, pp. 361, 417, 442, 518, 544, 638; and 2, p. 21. In the following case of *noma pudendi* no charge of rape was made against any person, but the facts may serve to show under what circumstances such a charge might be made.

A girl, æt. 5, died, as it was suspected, from the effects of poison. There was a congested state of the stomach, but no poison was found. The genital organs externally, and the skin around and beyond the anus, were intensely inflamed, swollen, and ulcerated, and in an approaching state of gangrene or sloughing. The hymen was destroyed posteriorly, and the lining-membrane of the vagina and uterus was much inflamed, of a dark purple colour, with softening and disorganisation of substance. The upper inguinal glands were enlarged on both sides. The child was in a neglected and dirty state. The mother attributed this diseased condition of the genitals to a fall which the girl had met with a fortnight before. There was no ground to believe that any one had had connection with the deceased.

In a case which occurred to Bullen, a girl aged seventeen was violated by several men in succession; she then became insensible, and was unable to state how often the act had been perpetrated. When examined the next day the genitals were bloody, inflamed, and painful; the hymen was ruptured, the fourchette torn, and the labia and perineum presented a dusky appearance of inflammation. In spite of treatment ulceration followed, and the clitoris, nymphæ, perineum, labia, and mons veneris sloughed away, leaving the pubis exposed. After a long illness the ulcer healed, and the girl left the infirmary. At no period were there symptoms of syphilis. Such a state of the parts, obviously a result of violence, might have been erroneously ascribed to *noma* or malignant ulceration or mortification of the genitals, as is observed in some eruptive fevers (*Dub. Med. Press*, March, 1840; Beck's "Mod. Jurispr.," vol. i., p. 60).

Evidence from Vaginal Discharges.—The existence of a purulent discharge from the vagina, as a result of vaginitis or inflammation of the vagina, has been erroneously adduced as a sign of rape in young children. The parents, or other ignorant persons who examine the child, often look upon this as a positive proof of impure intercourse; and perhaps lay a charge against an innocent person, who may have been observed to take particular notice of the child. Some cases are reported by which it would appear that men have thus narrowly escaped conviction for a crime which had really not been perpetrated.

A purulent discharge with aphthous ulceration is occasionally a result of simple, *i.e.*, non-venereal vaginitis (inflammation of the vagina) in young children. It may arise from local causes of irritation—as worms or uncleanly habits—and is observed especially in children of a scrofulous habit. It is frequently met with in girls up to six or seven years of age; and children thus affected have been tutored to lay imputations against innocent persons for the purpose of extorting money. Wilde (*Med. Leg. Obs.*, 1853) relates the following:—

A charge was raised against a respectable man that he had had intercourse with, and produced disease in, two children. The day and hour were circumstantially given, extorted as it appears from the children by the parent, and the man was put upon his trial. The appearances were such as are usual in these cases—a purulent discharge from the vagina, with some excoriation, but no bruise, laceration, or mark of violence on the pudendum. There had not been any penetration of the vagina. The charge against the prisoner, although unsupported by any affirmative circumstances, received some strength from the admission made by one medical witness for the prosecution—namely, that the appearances *might* have been the result of violence, and that the discharge *might* have been produced by friction with the member of a healthy man (Wilde, *op. cit.*, p. 14). It was proved that the prisoner was not affected either with gonorrhœa or syphilis. Geoghegan, Churchill, and other medical witnesses of repute, gave testimony to the effect that the child was labouring under an ordinary form of disease, and that there was no medical indication that it had been subjected to any kind of violence. This testimony was not considered by the Court to furnish a complete answer to the charge, since it was inferred that the appearances on the child *might* have been caused by the accused, without any marks of violence being left on the pudendum. So strong was this feeling, that, had the case rested here, it is probable the accused would have been convicted upon the unsupported statement of the child. An alibi was, however, clearly proved, and the man was acquitted.

Casper relates various instances of a similar character, and there would seem to be no doubt that in olden days men have even suffered capital punishment from false charges of this nature.

We have still to admit that these discharges of a simple character may occur, but accurate bacteriological examination of pus from cases has tended to show that after all a large proportion, something like 75 per cent., of them are gonorrhœal (Herman, Hunt. Soc. Trans., 1903—4), a position which is easily understood now we know how widely spread the gonococcus is, and how numerous are the opportunities for its transfer to the pudenda of small children.

Dr. Herman (*loc. cit.*) quoted numerous instances of such transference from flannels and sponges, and the editor can corroborate this view from an unsuspected source, for in 1907 he had to investigate an occasion in which nearly all the children in a hospital ward were thus infected by the carelessness of a nurse. Ryan long ago (*Med. Gaz.*, vol. 47) traced the origin of a discharge in two children to their being washed in a vessel of water with a sponge used by a young woman infected with gonorrhœa, thus anticipating modern research.

If a discharge be present, a swab of sterilised cotton wool must be dipped into it, and the moistened swab used to inoculate a culture medium (for details of the procedure *vide* any manual on bacteriology). If the gonococcus can then be identified, no doubt remains as to the nature of the discharge; if a negative result ensues after two or three trials most complete proof is obtained that the discharge is not gonorrhœal. [Under "Divorce" will be found a report of a case in which evidence thus obtained was crucial.]

Admitting then, as we are compelled to do, that most of such discharges are really gonorrhœal, it remains to discuss the bearing of the fact on the question of the alleged offence, and the nature of the medical evidence which can honestly be given either for or against the accused.

Time is the first important factor. When gonorrhœa is acquired in the usual way by sexual connection there is always an interval of from two to four days (occasionally it may be nearly a week) between infection and the appearance of a discharge with marked inflammatory redness of the mucous membrane. When syphilis is similarly acquired the interval between connection and the appearance of a chancre is very much longer, usually about three weeks, varying from two to four; with other syphilitic manifestations (rash, condylomata, etc.) the interval is still longer (six weeks to three months). When other venereal troubles are thus caused the interval is of less certain duration, but commonly from two days to a week elapses before a disharge is seen with evident ulceration.

The deductions to be made from these facts of time are self-evident, but obviously they vary with each set of circumstances, the most important point being to remember that a discharge cannot appear within twenty-four hours of the offence if the offence was the cause of the discharge. If there is a discharge, and if the offence is alleged to have occurred some days previous to examination, then the proof of cause and effect will have to depend upon other factors, the discharge itself being merely compatible with the accusation.

The next obvious point is a question to which unfortunately no positive and reliable answer is forthcoming, which is this: Given that one of the two parties is suffering from a venereal infection and the other is not, is it certain that the disease will be communicated to the other party? The probabilities are certainly very high, but facts would seem conclusively to prove that they are not 100 per cent., and if they are not 100 who is to prove that the case in dispute may not be an exception?

A case somewhat in point occurred to the editor in 1908—

A man was brought to him for examination on account of his being charged with raping a little girl. The girl undoubtedly had a gonorrhœal discharge. The man denied having the disease. Simple clinical examination (glands, etc.) rendered it probable that he had at some time had gonorrhœa, but equally suggested that he had not now got it—a very thorough bacteriological examination proved negative. On this negative result the accused was discharged by the magistrate.

A point here was this, granting that the girl had gonorrhœa, ought not the man also to have exhibited it in a recent state? The negative result of bacteriology could not be held to prove that he had not gonococci concealed in his urethra, but it certainly proved that he had not got it in an acute form, which was also proved by the absence of discharge.

It must be admitted that a man may be *apparently* free from disease and yet have in his urethra gonococci which in him are incapable of causing a discharge, but which transplanted to a new field in the vagina, may there cause a severe attack of gonorrhœa with profuse discharge; this position has been proved over and over again by clinical observation in newly married people as well as by bacteriological research (Bulloch).

The man was undoubtedly lucky to be discharged, but the editor feels that he showed no bias nor did he unduly stretch the negative evidence he gave.

The matter then resolves itself into this so far as vaginal discharges are concerned. The medical man must make most minute inquiries as to the time when the child was first known to have a vaginal discharge and compare this with the time of the alleged offence and see if it be possible for the relationship of cause and effect to be established, a relationship much easier to establish or refute in the case of syphilis than of other venereal troubles. If this possibility be established he should then carefully examine the accused, if there be such a person, and again see if the same chain of evidence may be made good from this end. If the chain breaks at either end he must admit it at once; if it remains good all through he must then state that from medical evidence the accusation is possibly true, at any rate compatible with medical evidence, but its positive truth must largely depend on the other factors, general evidence, evidence of violence, etc.

Hamilton relates a case in which syphilis was communicated to a girl, æt. 6, by a boy aged 19.

In this case the accused was found to have numerous sores around the orifice of the prepuce, and on examining the little girl there were chancrous excoriations on the inside of the labia. Other syphilitic symptoms manifested themselves. The prisoner was convicted.

It is in cases such as these that the examination of the accused affords such excellent evidence, either confirmatory of his guilt or strongly suggesting his innocence.

Gonorrhœa is a disease of very uncertain duration—weeks, months, or even years; it is therefore very unwise for a medical man to express an opinion as to its duration, as was done in the following case (an example to be avoided by careful witnesses).

R. v. *M'Donough* (C. C. C., October, 1843):—French and Tucker deposed that the gonorrhœa under which the prosecutrix (æt. 15) laboured had not existed longer than a week; it might have been of longer standing, but it certainly could not have existed for six weeks [this is probably an incorrect inference.—Ed.], the date at which it was alleged that the rape had been perpetrated by the prisoner, and the disease communicated. The prisoner was acquitted. (See Casper's "Gerichtl. Med.," vol. 2, p. 167.)

As a summary of these remarks on purulent and muco-purulent discharges, we may observe that they should not be admitted as furnishing corroborative (it can only be corroborative, not primary) evidence of rape, except,—1st, when the accused party is labouring under gonorrhœal discharge; 2nd, when the date of its appearance in a child is from the third to the eighth day after the alleged intercourse; and 3rd, when it has been satisfactorily established that the child had not suffered from any such discharge previously to the assault. It may be said, however, that all these conditions may exist, and yet the accused be innocent; for a child may, either through mistake or design, accuse an innocent person. This, however, removes the case entirely from the hands of a medical jurist.

Evidence from Violence other than that to the Pudendal Regions.—With respect to marks of violence on the *body* of a young child, these are seldom met with, because no resistance is commonly made by mere children. Bruises or contusions may, however, be occasionally found on the legs.

The older the victim, up to our present limit, the greater the possibility of such marks on the body and the more the importance to be attached to them when found, or at least to the explanation of how they were produced.

RAPE ON GIRLS OVER SIXTEEN AND WOMEN.

In these cases medical evidence is of much less value than in the previous class of cases, for though it may still be able to prove the fact of connection having taken place it can have very little influence upon the question of consent, the absence of which or the presence of fraud constitutes the essential element of rape. We must, however, consider the evidence that it may be possible to give.

Evidence from Violence to Parts other than Pudendal.—Girls who have passed the age of sixteen, and adult women, are considered to be capable of offering some resistance to the perpetration of the crime; and therefore in a true charge we should expect to find not only marks of violence about the pudendum, but also injuries of greater or less extent upon the body and limbs.

With respect to such *marks of violence* on the person, the exact form, position, and extent of these should be noticed; because a false accusation of rape may be sometimes detected by the violence being in a situation in which it was not probable that the ravisher would have produced it. When bruises are found, the presence or absence of the usual zones of colour may occasionally throw light upon the time at which the alleged assault was committed. As these marks of violence on the person are not likely to have been produced with the concurrence of the girl, they are considered to furnish some proof of the intercourse having been against her will. Bruises upon the arms particularly may be considered to be reasonable evidence of attempts at struggling, impressions of finger nails, too, would be suggestive. Strong corroborative evidence of a tale of struggle might be obtained from an examination of the accused for similar marks of bruises or scratches about the arms or face, and possibly even about his penis, though this is much less likely.

Evidence from Violence to the Pudenda.—In considering this point we must of course at once draw a distinction between a virgin and a married woman who is in the habit of having sexual connection; in the latter it is extremely unlikely that marks of pudendal violence will be found, though they must of course be looked for, because it is commonly assumed—whether justly or not may be open to doubt—that rape is associated with greater violence (on the part of the man) then sexual connection with consent. Now in a virgin the physical appearances of rape about the genital organs may be found, whether the connection has been voluntary or involuntary. Thus a recent rupture of the hymen, laceration or bruising of the vagina with effusion of coagula of blood, swelling and inflammation of the vulva, and stains of blood upon the person, dress, or furniture may be met with in both cases. The question of consent in these cases is of great importance. It is generally alleged as a defence, and a medical man will find himself compelled to answer this question:—Are the marks of violence found on the genital organs no more than you would expect to find in a girl who had really given consent?

A man with a wooden leg (his left leg having been amputated at the thigh) was charged with rape on a girl, æt. 15. She was examined soon after the violence, and the labia were found very much swollen, bruised, and inflamed. In addition to these appearances on the genital organs, there were the marks of bruises over the right chest, breast, and shoulder. These latter certainly suggested that connection had been violent without consent, but the man alleged that the girl gave her consent, whereupon the following question arose:—Could such appearances as you have described about the labia have been produced by connection with consent? A reply was given by the medical witness which left the matter in question doubtful.

The condition of the genital organs and the marks of violence on the body in this case were adverse to the theory of consent; but in expressing an opinion under such circumstances it must be remembered that, from the difference in the size of the organs of an adult male and a girl of fifteen years of age, it is hardly probable that intercourse with consent could take place without causing subsequent swelling and inflammation of the labia and vagina. In making an examination, the greatest care should be taken by the practitioner to fix, at the time of examination, a probable date for the marks of injury to the genitals or other parts of the body, as it is by the aid of such observations that the truth or falsity of a charge may be sometimes clearly established.

It is probable that in these cases of adult virgins, if the charge were well-founded, the hymen would be ruptured, as the intercourse is always presumed to be violent: but there might be some degree of penetration without this being a necessary result, especially if the membrane were small, or placed far up. At any rate, a girl may sustain all the injury, morally and physically, which the perpetration of the crime can possibly bring upon her, whatever may have been the degree of penetration; and for this reason, it is very properly laid down by our law, that the crime consists in the mere proof of penetration. The fact, however, is generally clearly made out by the statement of the girl. Girls of tender age are sometimes violated by boys; the amount of physical injury inflicted in such cases is usually less than when the assailant is an adult. It seems to the editor that when an adult man violates a virgin there must be such a degree of laceration that it would be impossible from it alone to estimate the problem "with consent or not?"

When a woman has already been in habits of sexual intercourse, there is commonly much less injury done to the genital organs. The hymen will, in these cases, be found destroyed and the vulva dilated. Still as the intercourse is presumed to be against the consent of the woman, it is most likely that when there has been a proper resistance, some injury will be apparent on the pudendum; and there will be also, probably, extensive marks of violence on the body and limbs. These cases are generally determined without medical evidence by the deposition of the woman, corroborated, as it should always be, by circumstances. This statement regarding the presence of *marks of violence* on the pudendum of a married woman, on whom a rape is alleged to have been committed, requires some qualification. In two cases of rape on married women, in which the crime was completed in spite of the resistance of the women, there were no marks of violence on the genital organs in either case.

In one (*R.* v. *Owen and others*, Oxford Cir., 1839), it appears that while an accomplice held the head of the woman with her face downwards between his thighs, the prisoner had forcible intercourse with her from behind,—her thighs having been first widely separated. In the second place an accomplice held the woman down on a bed by her neck, while the prisoner separated her thighs, and thus had intercourse with her. She was examined nine hours afterwards by an experienced surgeon, and he found no mark or trace of violence on or anywhere near her pudendum. There were bruises on her arms, neck, and legs, where she had been forcibly held down.

In each of these cases, it will be seen that the woman had not to struggle with a single assailant; and there can be no doubt that if a married woman is rendered powerless by many persons being combined against her, or if she is rendered insensible by intoxicatng drinks or narcotic vapours, a rape may be perpetrated, without any injury whatever to the genital organs. A separation of the thighs in a married woman will cause such a dilatation of the parts, as to render it easy for the male organ to penetrate the vagina without leaving any traces of violence on the labia or the female organs generally.

On the other hand, the vagina may be the seat of violence, and no marks to indicate a struggle or the application of force be found on the body.

A woman was knocked down, her clothes were pulled over her face, and a rape was perpetrated by the assailant. In the position in which she was held, with her arms and hands covered over, she was half-suffocated, and unable to offer any effectual resistance. She was examined on the evening of the day of the assault.

No marks of violence were found on her body, but the mucous membrane of the vagina at its commencement was contused, and in some portions lacerated; and blood was oozing from those parts.

It was considered that the statement of the woman was consistent with the fact that there were no marks of violence on her body. There was no reason to suppose that the injury to the vagina had been caused in any other way than by a criminal assault.

Evidence from Spermatozoa.—The law says nothing about emission (only about penetration), and therefore evidence from spermatozoa is not indispensable; at the same time it is occasionally necessary to examine spots and stains on the linen of the prosecutrix and of the accused, and there is one place, viz., the upper vagina, which might be examined as corroborative evidence.

The editor's attention to this last point was drawn by Dr. Mitchell, of Ambleside, who rightly enough argued "that it would be a very clever woman who would think of procuring semen (not to mention the difficulty of so doing) and injecting it into the upper vagina" for purposes of establishing a false charge; and therefore, supposing spermatozoa were found there, they would be very complete proof of completion of the act either with full penetration or in such a position that ejaculation threw them into the vagina. Their presence in the vagina is conclusive proof of connection, but not of rape. But their absence is no proof that connection has not taken place, for they may have been removed by washing or by discharges.

We have stated that a rape may be legally completed without reference to emission; but it is quite possible that there might be marks of emission without any penetration.

The fact that spermatic stains are found on the linen of the prosecutrix may become of importance in charges of assault with intent, as the following case (*R.* v. *Hamilton*), which was tried at Edinburgh, November 27, 1843, will show.

The prisoner, who was at the time labouring under gonorrhœa, was charged with a criminal assault upon a child. The shift worn by the prosecutrix, and other articles belonging to the prisoner, were submitted to Goodsir and Simpson for examination. They found spermatozoa in some of the stains. The stains on the linen of the prisoner and the prosecutrix were similar. The prisoner was convicted of an assault with intent to ravish. (*Cormack's Edin. Jour.*, April, 1844, p. 343.)

In a case of rape perpetrated on a child, Sawyer found in addition to blood-corpuscles and spermatozoa, some woollen fibres of a blue and red colour. This observation aided in fixing the identity of the assailant, since it was proved that the man wore a red flannel shirt over a bluish-grey woollen shirt. (*New Orleans Med. Gaz.*, June, 1858, p. 281.)

For methods of detecting spermatozoa, *vide* Vol. I., pp. 154 *et seq.*

A medical witness must be prepared to consider the precise value of evidence furnished by the microscope in the examination of stains on the dress of a man accused of rape. A shirt may present stains of blood, urine, mucus, or gonorrhœal discharge, some of which, but for the microscope, might be mistaken for spermatic stains. Admitting that the microscope enables an examiner to affirm that the stains have really been caused by the spermatic secretion, this does not prove that a rape has been committed, or even that intercourse has been had with a woman. Such stains may arise from natural discharge, or from disease (spermatorrhœa), and therefore in themselves they afford no proof of intercourse. If, from other circumstances in the case, it should be clearly and satisfactorily proved that there has been intercourse, then the presence of blood mixed with the spermatic stains might, in certain cases, justify an opinion that violence had been used. The discovery of spermatic stains on the dress of a woman furnishes stronger evidence of intercourse, attempted or perpetrated, than their discovery on the dress of a man; but, admitting that intercourse is thus proved, it may still have taken place with the consent of the woman. These stains, when found on the clothes of girls and infants, afford a strong corroborative proof of the perpetration or of the attempt to perpetrate the crime.

Evidence from Vaginal Discharges.—If discharges were confined to those of a recent gonorrhœal origin, a very large section of Gynæcology would remain unwritten, and for our present purpose it is only recent gonorrhœa that can be taken into consideration.

That vaginitis with a muco-purulent discharge has been observed to arise during febrile complaints, scarlatina, measles, etc., is well recognised. Moreover, diphtheria of the vagina in children and adults may lead to destruction of hymen, and even more serious trouble (*vide* "Impotency"). Therefore when a woman alleges that a purulent discharge has arisen from unwilling copulation, the case requires to be investigated with great care especially in regard to its nature (bacteriologically defined) and its duration.

It is possible, however, that a woman labouring under leucorrhœa may charge a man with the crime of rape, and affirm that this discharge had arisen from the act of the man. An inflamed and partially ulcerated (aphthous) state of the lining-membrane of the vulva may apparently give support to the accusation. It is impossible without the aid of bacteriology to distinguish such discharges from those of gonorrhœa; for a leucorrhœal discharge may resemble that of gonorrhœa. Such discharges, commencing before, but continuing and sometimes becoming aggravated after, marriage, have given rise to unfounded suspicions of infection from venereal disease imparted by the husband, and have thus led to suits of divorce (*vide* "Divorce").

In a case reported by Legneau a young married woman suffered from a discharge which was pronounced by a medical man whom she consulted to be gonorrhœal. This led to an application for a divorce. A further examination by other medical practitioners, with a complete history of the symptoms from which she had suffered, led to the conclusion that she was labouring under severe leucorrhœa when she was married, and that this was followed by granular vaginitis which accounted for the muco-purulent discharge. ("Ann. d'Hyg.," 1870, 2, p. 192.)

The power of distinguishing gonorrhœal or other venereal discharges from ordinary purulent discharges has been much debated in reference to the examination of women.

In a case which occurred to Lee a free purulent discharge from the vagina, with a reddened and inflamed mucous membrane, led him to believe that it was derived from gonorrhœal infection; but a week afterwards the inflammation had disappeared, the mucous membrane was of its usual colour, and the discharge not more than natural. This caused him to reverse his opinion, and to congratulate himself that he had not unjustly accused the patient. (*Lancet*, 1873, 1, p. 218.)

Bacteriological examination is the only safe guide, the clinical appearances and history and course of a vaginal discharge are very uncertain guides in legal medicine. We have already (*vide* p. 127) given the principles on which medical evidence must be founded, the adult vagina differing in this respect not at all from that of the child.

LOSS OF PHYSICAL EVIDENCE.

We have now considered the evidence, such as it is, that enables us to say that connection has taken place; it is necessary before closing the subject to say something as to the time at which we may expect this evidence to disappear.

The indications of rape, however well-marked they may be in the first instance, either soon disappear or become obscure, especially in those women who have been already habituated to sexual intercourse. After two, three, or four days, unless there has been an unusual degree of violence, no traces of the crime may be found about the genital organs. In the case of an adult married woman examined by Mayne, the appearances of injury which he discovered in and about the vagina had begun to heal in less than forty-eight hours; but in a case examined by Casper on the ninth day, the lining-membrane of the vagina was still reddened, and the parts were painful. In this case the hymen was completely torn through. ("Gerichtl. Med.," vol. 2, p. 157.) In married women, or in those accustomed to sexual intercourse, no inference can be drawn from a dilated state of the vagina. In unmarried women, and in children where there has been much violence, the signs of rape may persist and be apparent for a week or longer. Supposing that they are not found at the period of examination, it may be necessary to consider whether there has been time for them to disappear since the alleged perpetration of the offence; but in such cases it is rarely in a medical witness's power to express an affirmative opinion of the perpetration of the crime.

Casper met with a case in which a man, æt. 37, committed a rape on a girl only eight years of age; he was seen in the act, and defended himself on the plea of drunkenness. The girl was examined by a medical man on the day following. The labia were reddened, and there was injection of the membrane at the entrance of the vagina, which was very sensitive. As an illustration of the rapidity with which the marks of rape disappear in young children, when not attended with great physical injury, it may be stated that this girl was carefully examined by Casper *eleven days* after the assault. The sexual organs were then in their natural state, and there was not the least appearance of local injury.

Medical practitioners are not always sufficiently careful in the inferences which they draw from an examination of children at distant periods after an alleged rape. They allow themselves to be deceived by a plausible story, apparently consistent, and thus see proofs of rape on examining the sexual organs of a girl many weeks after the alleged perpetration of the crime; whereas had the girl been brought before them as a casual patient, and they had heard nothing of violent intercourse, they would have probably ridiculed the idea of setting up a charge of rape on so slender a foundation. The delay in having the examination made, unless satisfactorily explained, is always a suspicious circumstance. On one occasion a man was tried on a charge of rape on a girl a little above seven years of age.

About *six weeks* had elapsed before the girl was seen and examined by the medical man, who was the only witness for the prosecution; and after this long date he was prepared to swear at the trial that a rape had been perpetrated on the child. Fortunately for him, the prosecutrix was first called as a witness. The child, under cross-examination, swore that all that she had previously stated before the magistrates regarding the prisoner was untrue; and her evidence so clearly established the innocence of the man, that the case broke down, and he was at once acquitted.

But for the medical evidence against him, this man could not have been committed for trial on the charge; and it is therefore desirable to consider the medical facts and opinions on which he was committed. The medical man came to the conclusion that the girl had been violated six weeks before he saw her. There had, in his opinion, been penetration; the vagina was unnaturally dilated; there was a discharge from it, and an abrasion on the left side; the mucous membrane was generally inflamed. "Such appearances might have existed as the result of violence perpetrated on them three months previously. He had frequently examined the girl since, and his conclusion from the first examination had been confirmed. He thought the appearances could not be the result of any accident or disease; it was not impossible but improbable that they might be so." From what has been already stated on the medical proofs of rape, it will be obvious—1. That in this case there was no evidence of penetration by the male organ, and that the appearances, after six weeks had elapsed, did not in any way justify such an opinion from an examination then made. 2. That the discharge, the abrasion, and the inflammation of the vagina were all explicable on other grounds, and did not prove that a rape had been committed on the girl at the date assigned. It is highly probable that this child was suffering under that kind of inflammation and purulent discharge from the genital organs which has been elsewhere described as a fertile source of medical errors (*ante*, pp. 127 *et seq.*); but whether this be admitted or not, there was not the slightest proof, from the facts, that this girl had ever been violated, even supposing that her own evidence had not shown that the medical man had come to a wrong conclusion from the data before him. Dilatation of the vagina, if really present, could not have been the result of only one attempted intercourse with a child of such tender years, six weeks before the date of examination. This is a most flagrant example of biassed and improper medical evidence.

When there has been great laceration of the sexual organs, then certain appearances in the form of cicatrices may remain; but in all cases great caution should be observed in giving an opinion of rape having been perpetrated, from an examination made even two or three weeks after the alleged commission of the offence. Marks of violence on the person can never establish a rape; they merely indicate that the crime may have been attempted.

FALSE CHARGES OF RAPE.

False charges of rape may be easily set up by girls at the age of puberty. The falsehood of the charge may, however, be generally elicited by a careful examination of the prosecutrix, as in the following case.

A schoolmaster was charged (Swansea Lent Ass., 1869) with having committed a rape on a child of thirteen years of age. The child was unusually precocious for her age, and swore very distinctly to a rape having been completed. She made no complaint, however, for a week or ten days. On examination there was no mark of violence about her either recent or remote. The girl's story was inconsistent, and not supported by evidence. On cross-examination she said the prisoner committed the rape while they were standing up. The girl was short, and the prisoner, who was sixty years of age, was tall. She was quite sure that she was never placed on the ground. She resisted all she could, but could not help herself.

Her statement of the mode in which the act was perpetrated involved so many inconsistencies and improbabilities that the jury acquitted the prisoner.

Apart from such a case as this, we have a similar charge noticed under the heading of "Rape under Anæsthetics," p. 110, and also we may have conspiracies between girls or between a girl and her mother. Great circumspection and very close examination of the evidence is frequently required to extricate an unjustly accused man. The medical evidence can rarely be more than merely negative; it is practically impossible from it alone to say that there may not have been such a degree of penetration as constitutes rape in law. Few men, moreover, care to face a trial even for attempted rape or indecent assault, especially on a little girl, for the crime is so rightly detested; when a girl over sixteen or a woman is in question, juries are very prone to think "there cannot be smoke without fire."

Bayard met with a case of this kind, in which a woman charged a youth with having committed a rape upon her infant child.

On examination the sexual organs were found uninjured; and on inspecting the marks of blood on the clothes of the child, it was observed that the stains had been produced on the *outside*, and bore the appearance of smearing; the whole fibre of the stuff had not even been completely penetrated by the liquid. These facts established the falsehood of the charge ("Ann. d'Hyg.," 1847, 2, p. 219). A case involving a false charge of rape was tried at the Glasgow Aut. Circ. in 1859. One of the witnesses, an accomplice, proved that she had purchased some blood and handed it to the female who made the charge, and she saw her smear it over her person and on some sheets on which it was alleged the rape was perpetrated. The woman and her husband, who made this false chargo, were convicted of conspiracy.

Dr. Nelson Hardy thus reports a case of alleged rape, which is interesting, *apropos* of a medical man's duty in investigating cases:—

A servant girl of good character rushed home one night, knocked excitedly at the door, and, when her mother opened it, fell fainting into her arms. On coming to, she told the following extraordinary story: She had been out walking with another girl, and had passed a man whom she could not describe. She and the other girl had separated at the end of the road, and she had then come back alone in the direction of where the man had been. When she reached a lonely part of the road she had been thrown down by him on her back, hurting it against a stone. A white scarf had been placed over her mouth to prevent her screaming, and the man, holding down her arms, had had forcible intercourse with her. In less than half an hour the police had searched the road, but no scarf had been found. She was brought to the station, and I found evidence on her dress and hat that she had been on the ground. I also found a red mark about the middle of her back, where she complained of pain, but, on examining for any evidence of the alleged rape, I found absolutely none; no stains on the clothes, no marks of violence, not even a scratch on her limbs; no rupture of the hymen, and no sign of any irritation about the genitals. I came to the conclusion that she had probably enough been thrown down and that, in her fright, she had imagined the rest.

A few years ago the editor was consulted in a case in which a girl of seven or eight years described to him most circumstantially how her master had drawn her down on to him and inserted his organ completely into her vagina; notwithstanding these details her vagina showed not a trace of any damage, and the hymen was quite intact. An appeal to the common sense of the mother of the girl and the wife of the inculpated man led to an abandonment of the case.

PREGNANCY FOLLOWING RAPE.

It was formerly a debated question whether, in a case of rape, pregnancy could possibly follow; and this was even proposed as a rude test of the truth of a charge made by a woman. This question scarcely requires discussion. Such a defence would not be admitted as an answer to a charge of rape, nor to show under any circumstances that intercourse had been voluntary on the part of a woman. Conception, it is well known, does not depend on the consciousness or volition of a female. If the state of the uterine organs be in a condition favourable to impregnation, this may take place as readily as if the intercourse was voluntary: even penetration is not absolutely necessary for impregnation.

Many women in married life who anxiously wish for children have none, and *vice versâ;* and physical impediments do not suffice in all cases to explain these facts. Women are reported to have conceived during the states of asphyxia, intoxication, and narcotism. Ryan mentions a case in which a young woman became unconsciously pregnant from intercourse had with her by a man while she was in a state of intoxication, and in which it was clearly impossible that her volition could have taken any share. In married life there is no doubt that women frequently become pregnant against their will, and in a great number of cases without any consciousness of their condition until pregnancy is far advanced. Those who affirm that without the active will of the woman there can be no conception, must deny the existence of cases of impregnation in a state of unconsciousness; but the facts are too strong and too numerous to be met with a simple denial. A medical jurist, therefore, who relied upon pregnancy following alleged rape, as a proof of *consent* on the part of the woman, and would infer from this result that the intercourse must have been voluntary on her part, would inflict great injustice by such an opinion. The extrusion of an ovum does not depend on the will of a woman, but is a periodical condition; the action of the spermatozoa on this ovum is as much removed from the will of the woman as it is from that of the man.

This subject would have hardly required so much notice, but for the fact that in some trials it has been put forward with a view to discredit the evidence of a woman, where pregnancy has followed intercourse in a state of alleged unconsciousness. Any statement of this kind always requires a close examination, because, generally, there is a strong motive for falsehood on the part of a woman. In the case of *Bromwich* v. *Waters* the woman had had a child, but stated that she had not been conscious of any intercourse. The fact that she had borne a child did not prove that her statement was false, although a suggestion to this effect was made. We may fairly doubt whether the woman could have had intercourse unconsciously; but because impregnation followed this was no proof that she was guilty of falsehood or perjury.

Evidence of Violation in the Dead.

The body of a child or woman is found dead, and a medical man may be required to determine whether her person has or has not been violated before death. There is here some difficulty, because there may be no statement made by the deceased. The witness can seldom do more than express a conjectural opinion, from the discovery of marks of violence on the person and about the genital organs. Even if spermatozoa were detected in the liquid mucus of the vagina, or on the dress of a female, this would merely prove that there had been intercourse; whether violent or not would depend on the medical and circumstantial evidence.

In a case of murder tried at Edinburgh some years ago, the first point to be determined in the dead body was, whether a rape had or had not been committed. The examination of the stains on the dress was conclusive, when taken in conjunction with the other evidence. The jury convicted the man of a rape, and yet acquitted him of the murder, although the proof of the latter crime was clearer than that of the rape. (For a case in which evidence was obtained on the examination of a dead body, see Casper's "Klin. Novellen," p. 17.)

The case of *R.* v. *Kerr* (Carlisle Sum. Ass., 1889) is a very good illustrative case.

The proofs of rape from the deceased were:—two lacerations of the vagina, which, in an elderly woman who had borne two children, indicated violence; an excoriation on the abdomen; blood on the external genitals. The prisoner had an abrasion on his cheek, vomited matters on the back of his coat resembling exactly that which was exuding from the mouth of the deceased, while on the knees of his trousers were found embedded in mud (resembling that found in the locality where the deceased's body was found), some red woollen hairs resembling that of a petticoat worn by the deceased woman. The cause of the woman's death was suffocation from the impaction of vomited matters in the larynx, but as this was the result of an unlawful act—*i.e.*, rape—it became murder. The prisoner was seen coming from the spot where the deceased's body was found, and within a short distance from it, by two men who knew him intimately. It was proved that he and the deceased were walking in opposite directions at such times and places as would bring them to that spot shortly before the time he was met coming away, and when arrested some hours after his clothes were found wet and muddy, with the other appearances noted. He was found guilty and sentenced to death, but this was subsequently commuted to fourteen years' penal servitude, and in 1893 he was liberated.

Rape by Females on Males.

So far as we can ascertain, this crime is unknown to the English law. Several cases of this kind have, however, come before the French criminal courts.

In 1845, a female, aged eighteen, was charged with having been guilty of an act of indecency, with violence, on the person of a boy under the age of fifteen years. She was found guilty. In another case, which occurred in 1842, a girl, aged eighteen, was charged with rape on two children, the one eleven and the other thirteen years of age. It appeared in evidence that the accused had enticed the two boys into a field, and had there had forcible connection with them. This female was proved to have had an unnatural contraction of the vagina, which prevented intercourse with adult males. She was found to be labouring under syphilitic disease, and the proof of her offence was completed by the disease having been communicated to the two boys. She was convicted ("Ann. d'Hyg.," 1847, 1, p. 463).

Casper describes cases of this description which have fallen under his observation (" Gerichtl. Med.," vol 2, p. 129; and " Klin. Novellen," 1863, p. 15). By the Penal Code of France, it is a crime in either sex to attempt intercourse with the other, whether with or without violence, when the child is under eleven years of age. That this offence is perpetrated in England cannot be doubted. It is by no means unusual to find, in the wards of hospitals, mere boys affected with venereal disease. In some instances this may be due to precocious puberty; but in others it can only be ascribed to that unnatural connection of adult women with male children which is punished as a crime in the other sex. The only accessible medical evidence would consist in the definite proof of transmission of gonorrhœa or syphilis from the woman to the child, though it must be remembered that syphilis at any rate can be communicated by kissing.

SUB-SECTION H.—ABORTION.

To a lawyer this word has a somewhat different meaning to that which it has to a medical man: to the latter it is merely an untimely emptying of a uterus which contains the products of a conception; to the former the word conveys the idea of a criminal offence, though such may not have been committed, for it is only the artificial emptying (or attempts to empty) of the uterus that is a crime, and many abortions are produced by mere disease and accident.

In a medico-legal work, however, the subject must be thoroughly discussed from every point of view, and we shall therefore consider it according to the following table:—

1. THE LAW ON THE SUBJECT.
2. THE NATURAL CAUSES OF ABORTION (*i.e.*, DISEASE).
3. THE ARTIFICIAL PRODUCTION OF ABORTION WHICH MAY BE JUSTIFIABLE OR CRIMINAL.
4. THE EVIDENCE TO BE OBTAINED OF CRIMINAL ABORTION.
5. FEIGNED ABORTION.
6. THE ABORTION OF MOLES AND MONSTERS, EXTRA-UTERINE FŒTATION.

(1) THE LAW ON THE SUBJECT OF ABORTION.

The legal position of attempts to empty a pregnant (or a non-pregnant) uterus is fixed by 24 & 25 Vict. c. 100, sects. 58 and 59; these sections have not lately been amended and run as follows:

"58. *Every woman, being with child, who, with intent to procure her own miscarriage, shall unlawfully administer to herself any poison or other noxious thing, or shall unlawfully use any instrument or other means whatsoever with the like intent, and whosoever, with intent to procure the miscarriage of any woman, whether she be or be not with child, shall unlawfully administer to her or cause to be taken by her any poison or other noxious thing, or shall unlawfully use any instrument or other means whatsoever with the like intent, shall be guilty of felony, and being convicted thereof shall be liable, at the discretion of the Court, to be kept in penal servitude for life or for any term not less than three years—or to be imprisoned for any term not exceeding two years, with or without hard labour and with or without solitary confinement.*

"59. *Whosoever shall unlawfully supply or procure any poison or other noxious thing, or any instrument or thing whatsover, knowing that the same is intended to be unlawfully used or employed with intent to procure the miscarriage of any woman, whether she be or be not with child, shall be guilty of a misdemeanour, and being convicted thereof shall be liable, at the discretion of the Court, to be kept in penal servitude for the term of three years, or to be imprisoned for any term not exceeding two years, with or without hard labour.*

It will be noted—

(*a*) That the statute only uses the word "miscarriage," including in that term comprehensively the emptying of a pregnant uterus at any time of conception, ignoring altogether the technical terms abortion, miscarriage, premature confinement, which are merely convenient descriptive words for medical men. The natural inference is that in legal trials the medical witness should always speak of the event as "miscarriage" in his evidence.

(*b*) Throughout both sections it uses the word "unlawfully" without attempting in any way to define its meaning: as it nowhere defines a "lawful" emptying of the uterus the presumption is that such a thing does not exist, a presumption which is especially important for medical men to remember when for what seems to them good and sufficient reason they contemplate emptying a pregnant uterus (*vide* below, "Justifiable Abortion").

(*c*) That in attempts by a second person to empty a uterus it makes no difference in the nature of the crime if the uterus do not contain any results of impregnation at all. But apparently the woman herself commits no crime by an attempt to empty her uterus when it does not contain a fœtus, though if it does she is guilty. The logic of this is not at all apparent.

Notwithstanding the above sections, and the severe punishment provided, there can be no reasonable doubt but that abortion is a very common crime. Unless the woman dies, however, there is but little chance of inquiry or of detection.

When the death of the woman takes place, the crime is considered to be murder, although the accused may not have intended to destroy life. The law was thus laid down by Bramwell, B., in Stadtmühler's case, *infra*:—"If a man for an unlawful purpose used a dangerous instrument, or medicine, or other means, and thereby death ensued, that was murder, although he might not have intended to cause death, although the person dead might have consented to the act which terminated in death, and although possibly he might very much regret the termination that had taken place contrary to his hopes and expectations. This was wilful murder. But the learned counsel for the defence had thrown on the judge the task of saying whether the case could be reduced to manslaughter. There was such a possibility, but to adopt it would be, he thought, to run counter to the evidence given. If the jury should be of opinion that the prisoner used the instrument not with any intention to destroy life, and that the instrument was not a dangerous one, although he used it for an unlawful purpose, that would reduce the crime to manslaughter. He really did not think they could come to any other conclusion than that the instrument was a dangerous one, if used at all. Then, if it were so used by the prisoner, the case was one of murder; and there was nothing for the case but a verdict either of murder or of acquital."

This decision was given before the statute quoted above was enacted. Only one person has since been hanged for abortion pure and simple, though there has been an execution—this was a man named Heap, executed at Liverpool in 1876—in a case where abortion-mongery has been combined with infanticide; in some cases the death sentence has been pronounced, but with a full knowledge that it would not be carried out. In the years following the case of the man Heap there were convictions for similar crimes (there had been none for some time before that case)—that of Cornelius Asher, a herbalist at Leicester, in 1876; that of Ann Cartledge, a midwife, in 1877; another of a woman in 1879; two separate cases in 1880 (the two Colmers and an unqualified practitioner named Haywood); and the case of a chemist named Hollis in 1882—in all of which reprieves followed. In all of these cases, in spite of the recent precedent of Heap's case, the death sentence was not carried out, and in them, and in all such cases since, the Home Secretary, and not the judge who tried the case, has fixed the penalty for the crime. There is a great reluctance amongst juries to bring in verdicts of wilful murder for abortion, from an idea that there is no "malice aforethought" in the act, and as a matter of fact the abortionist hopes that she will recover and may do his best to assist recovery: the leader in the *Lancet*, vol. 1, 1899, in which the above, cases are given, proceeds as follows:—

"This crime has been, technically, murder, the jury only convicting because ignorant that a death sentence would be passed or expecting confidently its commutation. The difficulty of persuading the jury of even the technical guilt of murder on the part of the prisoner is shown by the way in which the law has been laid down in the three recent instances already referred to. According to the Attorney-General in the Collins case (and apparently the judge took the same view), 'if the act done was not in itself of necessity dangerous then the jury might find a verdict of manslaughter and not murder.' According to Mr. Justice Bigham in the Whitmarsh case, 'If the jury could bring themselves to think—he did not see how they could—that though the prisoner might have administered the injection yet nevertheless as a reasonable man he could not have contemplated that it would result in death, it was competent for them to say that he was not guilty of murder but he was guilty of the lesser crime of manslaughter.' According to Mr. Justice Phillimore in the Wark case, 'if a person committed any felony on the body of anyone to whom thereby death resulted he was guilty of murdering that person.' It is in consequence of such conflicting and irreconcilable enunciations of the law that we have urged the desirability of legislation with regard to cases of what is sometimes known as 'constructive murder,' a convenient term against the use of which Sir FitzJames Stephen once emphatically protested. Failing this we have suggested the possibility of a uniform practice of indicting for manslaughter, except perhaps in any exceptionally heinous cases as may possibly arise. The object of such legislation or practice would be to produce consistency and prevent the possibility of a criminal being acquitted through sympathy or prejudice. It is quite another matter to urge that a jury's verdict should be rendered wholly ineffective where it simply amounts to a finding that, whatever crime the acts committed involve, the prisoner was privy to it. To do this would be highly undesirable, even if the judge trying the case admittedly assumed a responsibility in directing the jury from which some of his colleagues would have shrunk."

Mr. Justice Darling in March, 1899, in charging the grand jury at Chester Assizes referred at length to the case of William Upton, who was alleged to have killed a woman named Mary Murray at Macclesfield by means of an illegal operation. The learned judge referred to the notorious cases which had recently been tried, and pointed out that where the death sentence had been pronounced everybody in court knew that it would not be carried out. Such a state of the law, he considered, put judges in an undignified and absurd position. It was not well that the highest penalty which man had it in his power to inflict should be gravely decreed against criminals with the full knowledge that the whole proceeding was nothing but a sham from the beginning. He advised the jury upon his own initiative and until some consensus of opinion had been arrived at in the matter not to return a true bill for murder if they thought that the wound, though inflicted for an unlawful purpose, was not intended to kill, and only to find a true bill for murder when it was intended to kill the woman, or at any rate when those who performed the operation did not care if the woman died or not. The grand jury adopted Mr. Justice Darling's suggestion when they came to deal with the matter, and found a true bill for manslaughter only.

In the year 1895 the following case for the opinion of counsel was stated by the Royal College of Physicians. We may conveniently head it with the phrase

Professional Secrecy in Cases of Abortion.

"The crime of procuring abortion is unfortunately only too common, and a certain set of practitioners are known to practise it somewhat extensively. Of these persons nothing more need be said. They are clearly guilty of felony, and must take the consequences of their acts if found out. The subject is, however, surrounded by difficulties to practitioners of another class, who are not unfrequently called in to advise in cases in which they either know or strongly suspect that abortion has been actually procured or has been attempted. In such cases the woman often suffers severely and her life may be at stake, so that the practitioner naturally finds it necessary or desirable to obtain information as to what has actually taken place by any means in his power. This often includes a confession on the part of the woman, given probably under the seal of secrecy, expressed or implied. The first question that suggests itself is whether or not such a communication is privileged, as in the case of a solicitor and client. It is feared that this question must be answered in the negative, and, if so, the further question at once arises as to what is the duty of the practitioner who has obtained such information, whether by confession or otherwise. If he divulges the information so obtained, he would certainly be considered by the woman in question, and probably by her family, to have been guilty of a gross breach of professional confidence, whilst if he keeps the secret it may well be that he will render himself amenable to the criminal law. By simply keeping the secret he may well bring himself within the definition of the offence of misprision of felony, which is said to be 'the concealment of some felony committed by another, but without such previous concert with, or subsequent assistance of him as will make the party concealing an accessory before or after the fact.' It may well be, however, that in the course of his practice the practitioner may make himself an accessory after the fact, which is

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itself felony. An accessory after the fact is said to be one who, knowing a felony to have been committed 'by another, receives, relieves, comforts, or assists the felon.' Now, the woman concerned is as much a felon as the person who operates upon her or administers drugs to her for the purpose of procuring abortion, and it is difficult for a medical man to be of any use to his patients without bringing himself, at all events, within the wording of the definition.

"The branch of the subject above dealt with has been taken first because it is the commonest in practice, but a practitioner is not unfrequently himself solicited to do the unlawful act. There can, of course, be no doubt but that his duty is to refuse to have anything to do with the matter, but does his legal obligation end there?

"Sometimes the woman in effect says, 'If you will not do it, I shall get it done by someone else,' and perhaps she may name the person. Or, after having been solicited to procure the abortion, and having refused, the practitioner may hear or be made aware that the woman has had a 'miscarriage'; in other words, he knows or is morally certain that an illegal operation has been performed.

"Or a woman on whom he is in attendance may admit that on previous occasions she has herself had one or more abortions procured in the past. In such cases if the practitioner does nothing, it seems unlikely that he would thereby make himself an accessory before the fact, the definition of such an accessory being 'one who being absent at the time when the felony is committed, yet procures, counsels, or abets another to commit a felony'; still he may perhaps be guilty of misprision of felony and punishable accordingly.

"Another class of cases gives rise to somewhat different considerations. It not unfrequently happens that a medical practitioner who is in attendance on a woman during her pregnancy, or at her confinement, becomes convinced that she will almost certainly die unless the child is in some way got rid of. He sees that unless something of the sort is done both mother and child may perish, but the former can be saved at the expense of the destruction of the latter. In such a case the question arises as to whether he is legally justified in destroying the child to save the mother. In practice such action is not uncommon, but that does not seem to affect its legality.

"Counsel will please advise the College:

"1. Has a medical practitioner any privilege with regard to secrets confided to him in the course of his practice analogous to the privilege as between a solicitor and client, or otherwise?

"2. What is the duty of a medical practitioner who knows or believes he is in attendance in a case in which criminal abortion has been practised? And is there any distinction to be drawn between the several cases mentioned above?

"3. Does the law forbid the procurement of abortion during pregnancy for the purpose of saving the mother's life?

"4. Does it forbid the destruction of the child during labour where such destruction of life is necessary to save the mother's life?

"5. In the event of the questions 3 and 4 being answered in the affirmative, is a medical practitioner blameless if, in order to escape the risk of prosecution, he refrains from rendering assistance, and thus deliberately sacrifices the life of the patient when he could save it either (*a*) by inducing abortion, or (*b*) by destroying the child during labour?

"6. If it were desired to procure the alteration of the law, what would be the best mode of procedure?

"7. To advise generally on the case.

"The answers were as follows:—

"1. We are of opinion that there is no privilege attaching to statements made to a medical practitioner by his patient.

"2. We are of opinion that it is the duty of the medical practitioner who knows or believes that he is in attendance in a case where criminal abortion has been practised, to attend his patient to the best of his skill, and that he does not thereby render himself liable as an accessory after the fact, so long as he does nothing to assist the patient in escaping from or defeating justice. (See 1 Hale, 332.) We do not think the medical practitioner is liable to indictment for misprision of felony (an offence which is nearly obsolete) merely because he does not give information in a case where he *suspects* that criminal abortion has been practised. In the case suggested, where the name of the person is given who is going to commit such an offence, we think it is the duty of the medical practitioner at once to warn such person that such a statement has been made.

"3, 4 and 5. We are of opinion that the law does not forbid the procurement of abortion during pregnancy, or the destruction of the child during labour, where such procurement or destruction is necessary to save the mother's life.

"6. If we are right in our views, no alteration of the law would probably be desired.

"7. The duty of the medical practitioner as to giving information in particular cases, or as to his action where the life of the patient is in danger, must, we think, be exercised according to his discretion."

(2) Illness and Disease as Causes of Abortion (More Medico).

If a medical witness be asked the question, "Was this uterus emptied as the result of disease or illness?" it is impossible by physical examination alone to answer specifically; he is obliged to depend upon other circumstantial or direct evidence as to the nature, or even the existence, of disease.

In quite recent delivery he may for instance find the woman still very obviously suffering from an acute fever, but in the majority of cases he will have to depend upon his ordinary professional knowledge as to the tendency of certain diseases, if present, to cause abortion.

These *natural* causes are so frequent that, according to Whitehead's observation, of 2,000 pregnancies one in seven terminated in abortion.

It is impossible in a medico-legal work to give a complete list of all these, but the following are well recognised:—

(*a*) **Specific Fevers** of all kinds. During an attack of any of them, the uterus may empty itself; in quite recent cases definite evidence of them may be forthcoming.

(*b*) **Excessive Vomiting** of pregnancy—may produce it, but is more commonly the alleged reason for induction of labour.

(*c*) **Chorea Gavidarum**—pregnant women are liable to chorea, which may end in abortion.

(*d*) **Bright's Disease**—especially if advanced.

(*e*) **Advanced Heart, Lung, or Liver Disease**—may cause abortion, and are certainly dangerous complications of pregnancy.

(*f*) **Syphilis**—an extremely frequent cause of abortion, and that too without marked syphilitic symptoms other than the repeated abortions.

(*g*) **Uterine and Ovarian Disease**—these frequently arise from an abortion or badly managed delivery, but once established they cause numberless abortions.

(*h*) **Disease of the Placenta**—usually syphilitic or accidental separation of a portion.

(*i*) **Disease, and especially the Death of the Fœtus**. These may own any of the above maternal causes; if once established they almost inevitably (death practically invariably) lead to abortion (*vide* below, "Instrumental Abortion").

The reader is referred to "l'Avortement," by Professor Brouardel (Baillière et Fils, 1901) for fuller details on the history and methods of abortion.

The case of *R.* v. *Wark*, Liverpool Ass., December, 1898, before Mr. Justice Phillimore, is of some interest in connection with the diagnosis of criminal abortion, in that medical evidence proved that the dead woman had suffered from syphilis three years previously, and this was urged by the defence as a possible cause of the abortion. There was circumstantial evidence suggesting the use of a catheter, and, indeed, a "dying declaration" by the woman that she had herself used it on her own person. Dr. Paul testified that death was due to septicæmia, and that there was nothing locally to show whether it was an abortion due to disease or one due to instrumental interference, or even to the *lawful* [?—Ed.] action of another medical man in an attempt to save the life of a woman who was dying of septicæmia. Dr. Paul was not acquainted with any case of a woman using a catheter on herself (*vide infra*). Mainly on the circumstantial evidence, therefore, the prisoner was found guilty and condemned to death. He was subsequently respited and condemned to some years' penal servitude.

The full reports of the case contain some interesting legal points in reference to the "dying declaration" of the woman, the admission of evidence, and the exact legal position of the law on abortion, but they are not of sufficient medical interest to warrant insertion here.

(3) Justifiable Abortion.

Strictly speaking, as we have already shown, there is no such thing as justifiable abortion [counsel's opinion, *supra ?*—Ed.]; the law recognises no such possibility; a medical man must always remember this when he contemplates emptying a pregnant uterus.

It is obvious that the only reasons that can be thought of by an honourable man as justifying the induction of labour are (1) to save the life of the mother; (2) to save the life of the child. (Some religions will not contemplate the first reason, but that we are not now concerned with.) It cannot be done for the sake of family honour nor any similar ethical reason.

To prevent a false charge, a chance of blackmail, and even to prevent misapprehension on the part of a woman, a medical man should therefore, before emptying a uterus, place himself in the position of being able to prove that he did it for one of the two reasons given above, *and for no other*. Details of the actual grounds for belief that life can be saved by the act would here be out of place; they can be found in any good work on obstetrics; suffice it to say that pelvic deformities, chronic heart and lung disease, and vomiting of pregnancy constitute the bulk of them.

The golden rule is **never to empty a uterus without first having a second professional opinion as to its necessity**; if this opinion be adverse, do not do it; if it be favourable it is well to get it in writing, and it is well also to get the written or attested consent of the woman and her husband, and then proceed to do it with all the skill and care possible. The death of the fœtus is at any time the most certain means of causing the womb to empty itself, but after the sixth month the operation is performed usually with a view to preserving this life, and steps must be taken accordingly.

It is undoubtedly true that parturition will sometimes take place safely at the full time, even when the deformity of the pelvis is apparently so great as to lead many accoucheurs to suppose natural delivery to be impossible. Hence a cautious selection should be made, because the operation is necessarily attended with some risk; and it does not insure safety to a woman and child. All that we can say is, that it should place her in a better position than she would be in if the case were left to itself; and of this the practitioner should feel assured. In the event of the death of the woman or child, he exposes himself to the chance of a prosecution for a criminal offence. If the child were born alive, and died merely as a result of its immaturity, this might give rise to a charge of manslaughter. Several practitioners have been tried upon charges of criminal abortion—whether justly or unjustly it is not necessary to consider; but they had obviously neglected to adopt those simple measures of prudence the observance of which would have been at once an answer to a criminal charge. Because one obstetric practitioner of large experience may have frequently and successfully induced premature labour, without observing the above rule, and without any imputation on his character, this cannot shield another who may be less fortunately situated.

(4) Criminal Abortion.

Abortionists (their existence as a class is unfortunately only too evident from the cases that arise from time to time) are of varying degrees of skill, from the black sheep of the medical profession (who may perform the deed *secundum artem*), through the midwife (who has some superficial acquaintance with the anatomy of the parts), down to the totally ignorant layman (who is interested in a particular case, but makes no practice of the act).

To detect the action of the first class, and even the sober attempts of midwives, is usually quite impossible by strictly medical evidence; it can only be done by inquiry into motives, and fees, and surrounding circumstances, inquiries more in the province of the detective than the medical jurist. We must, however, consider in detail the means that are commonly employed with a view to estimating how we may detect them in certain cases.

The means employed are either—

A. Violence, which may be	(*a*) general	intentional accidental	or a combination of the two—Violence and Drugs.
	(*b*) local	skilled unskilled	
B. Drugs.			

A. Violence—(*a*) General.

(i.) *Intentional.*—Among the mechanical causes may be mentioned, severe exercise; and the violent agitation of the body, as by riding or driving over a rough pavement, in which case no marks of violence would be apparent. Any physical shock sustained by the body may operate indirectly on the uterus. Blows or violent pressure on the abdomen are sometimes resorted to, but in these cases the marks of violence will be commonly perceptible.

Tidy (*Leg. Med.*, pp. 164 and 165) mentions also copious bleedings (in the 17th century), over-tight-lacing, as having been resorted to. He remarks that such means usually fail in their purpose, and not only so, but leave their traces in view for all to see, and quotes the two following cases in illustration:—

(1) In the Assize Court of the Loire-Inférieure, it was proved that a peasant, who had seduced his servant, and wished to make her abort, mounted on a strong horse and put the girl on the same horse, then galloped wildly hither and thither, throwing her down on the ground whilst in full gallop, and this repeatedly. Having tried this twice without success, he conceived the horrible idea of applying to her stomach bread just taken from a very hot oven. This means, like the former, failed, the poor victim ultimately giving birth to a living and well-formed child at term (Brillaud-Laujardière, "De l'Avortement Provoqué," Paris, 1862, p. 279) (pp. 156, 165).

(2) A case quoted by Dr. Guibaut of a young Munich lady, living in California. Becoming pregnant, she wished to go to Munich to be delivered. In crossing the Isthmus of Panama a railway collision occurred. In consequence of this, labour pains set in. In spite of this she embarked for Portsmouth. She had a horrible passage, with further accidents. Notwithstanding these the pains subsided each time. On reaching Paris, she fell from the top to the bottom of the hotel stairs! Again she was seized with pains like those of labour. She was then eight months pregnant. Next day she departed for Munich, and was not confined till some days after her arrival in that city.

(See a similar case from Dr. Wagner, of Berlin, mentioned in Guy and Ferrier, p. 98.)

(ii.) *Accidental.*—This can only be separated from intentional by general evidence. Playing violent games in an advanced state might produce abortion.

(*b*) Local.

(a) **Skilled—leaving no traces of violence.**—Modern life has brought with it an amount of nervous and physical degeneracy of such a nature that an increasing number of women are unable to carry children to full term. Medical science has consequently been busy in perfecting the means of safely emptying a uterus when the life of the mother or the infant demands it. The use of Hegar's dilators, Barnes' bags, Champonniere's dilators, metal sounds, etc., etc., combined with the very strictest attention to even the minutest details of asepticism, have rendered the operation almost free from risk, and assuredly free from any traces that a medical jurist could detect as by themselves evidence of malpraxis. The only danger in the criminal use of such means lies in haste.

When the membranes are penetrated and the waters are discharged, uterine action is invariably induced, but the time which elapses from the performance of the operation to the commencement of labour is subject to great variation. Ramsbotham states that he has known the uterus begin to act in *ten hours* after the rupture, but in another case a week elapsed before its action commenced. As a general rule, uterine action is fully established in fifty or sixty hours. It must not be supposed, however, that where a criminal intention exists so long a period is required for removing the contents of the uterus. In a criminal attempt by a medical practitioner, in which the woman would be a consenting party to the act, the removal of the embryo or fœtus may be, and generally is, effected in a much shorter period of time. At any rate, the time for the completion of abortion could not be measured by cases in which the uterus has been left to undergo spontaneous contraction after the membranes had been punctured and the waters had escaped. There might, however, be great danger to a woman in the necessary manipulations. The reader will find reports, by Tardieu, of numerous cases of abortion as a result of mechanical means applied to the uterus, in the "Ann. d'Hyg.," 1855, 1, 406; and some good practical remarks by the same writer on the mode in which these inquiries should be conducted, in the "Ann. d'Hyg.," 1856, 1, 141.

Cases in which medical men have thus lent their aid are unfortunately only too common. In the *Lancet*, vol. 2, 1901, will be found an account of one such occurring in Sydney. What brought the matter to light was the death of the woman. The medical evidence showed that death was due to hæmorrhage, but there was nothing to show how delivery was brought about.

The Recorder's remarks at the Central Criminal Court, June 20th, 1904, are well worth attention. In charging the grand jury the Recorder referred to the case against Dr. Hicks, charged with the illegal use of instruments. "The circumstances of this last case," said the Recorder, "disclose a condition of morality which, I trust, has not spread very far or very wide. If it does there must ensue a decadence of our race, which must have most serious consequences. Had the woman in this case died the doctor would have been charged with murder. Of late there has been a tendency in such an event to minimise this offence to manslaughter, but by what process of reasoning this course is arrived at I have not been able to understand."

Midwives from their calling acquire considerable skill in procuring abortion, and it is to be feared that they lend themselves in some instances only too readily to the practice. The following case occurred at the Liverpool Spr. Ass., April, 1904:—

Betsy Hankin, 35 (on bail), was indicted for an offence at Little Hulton. The prisoner practised as a midwife, and it was alleged that, as a result of the offence she committed, a widow named Hurst was rendered dangerously ill. It appeared that what the prisoner did was done at the repeated request of Hurst. She had visited Hankin three times for a given purpose, and admitted she had said if she could not get right she felt "as if she could do something to herself." Mrs. Hurst had just been left a widow, and had six children to support. For the defence it was urged that, in view of Mrs. Hurst's distress of mind, the prisoner had led the woman to believe she had performed an operation when she had not, and that the illness in question came on naturally, the same kind of ailment having occurred to her twice before. Moreover, it was urged, the prisoner could not be convicted on the uncorroborated testimony of the chief witness. The jury found the prisoner guilty. A police superintendent was called, who stated, as to the prisoner's reputation, that she was "as well known as the parish clock for this sort of thing." The judge sentenced the prisoner—apparently to her great surprise—to three years' penal servitude.

Punishment seems to have but little deterrent effect, as the following shows (*R.* v. *Baudach*, C. C. C., March, 1904):—

From the evidence given it appears that the prisoner attended the deceased in August and December last, and on each occasion performed an illegal operation. After the last operation blood poisoning set in, and the patient died. On being questioned by the police, the prisoner left her house, and ultimately went to Germany. After the inquest was completed she returned, and was arrested. The jury having found the prisoner guilty, it was announced that she had already undergone a sentence of five years' imprisonment for a similar offence, and was tried again only last year upon a corresponding charge. On that occasion she was acquitted, but was severely censured for her conduct by Mr. Justice Lawrance. On the present occasion Mr. Justice Grantham, on receiving the verdict of the jury, remarked upon the gravity of the offence, and sentenced her to seven years' penal servitude.

As elsewhere remarked, it is the certainty of detection and not the severity of the sentence when detected that really acts as a deterrent from crime.

On November 20th, 1904, Ernestine Katz, a midwife, was tried (*R.* v. *Katz*) at the Central Criminal Court before Mr. Justice Darling on the charge of having murdered a young woman named Kate Kennedy. The prisoner, a German, resided in Whitechapel, and it was alleged that on June 30th she performed an illegal operation upon the deceased by means of "an instrument." The case for the prosecution was that the deceased woman's death was occasioned by the operation which the prisoner was alleged to have performed upon her.

Much legal interest was attached to the manner in which the depositions had been taken, and a long argument ensued, but the main question for the jury was as to whether the prisoner was guilty of murder or of manslaughter, the facts of the case being perfectly simple. It appeared that when the prisoner was arrested a number of documents were found upon her which showed that in 1897, at Berlin, she was charged with an offence of this very same nature, and that she absconded from her bail to this country. Mr. Justice Darling is reported as saying that the jury had found the prisoner not guilty of murder but guilty of manslaughter, having been informed that that verdict was hardly possible if they were of opinion that she, in doing what they found that she had done, did not know that she was performing an act which was likely to have fatal results. In their opinion, apparently, the prisoner was an extraordinarily ignorant person in the practice of the business which she carried on. The judge plainly intimated that he did not share the opinion of the jury, and we entirely endorse his view. It would seem impossible that the prisoner did not know that she was performing an illegal, and possibly a dangerous, act.

With regard to the exact way in which skilled instrumental interference brings about abortion, it is worth while to say a few words, as some doubt was once (at the Leeds Assizes, in 1897) expressed on the point; in *R.* v. *Bower* a sound was said to have been passed by the prisoner and the ovum was said to have been expelled entire, *i.e.*, still enclosed in its membranes, with placenta attached. The defence said that abortion could not have been procured by simply passing a sound without rupturing the membranes. This defence rested upon a statement to the required effect appearing in a work on Medical Jurisprudence.

It must be distinctly understood once for all, and laid down emphatically, that such a defence is absolutely without basis in medical fact; the position may be succinctly stated in a few paragraphs.

It is possible that a bougie, catheter, or similar instrument, may be passed into a pregnant uterus without abortion following, but such an event would be unusual: this might happen in the very early days because the instrument had not disturbed the ovum in any way. It might happen in the later stages because the womb was particularly healthy, and soon repaired the injury done. Abortion does, as a rule, occur, because, either the membranes happen to be ruptured, leading to death of the fœtus; or a portion of the placenta is separated, and the uterus is too weak or irritable to repair such damage; or lastly, it may happen simply because an irritable uterus resents even the simple introduction of anything through its cervix. These statements are based on the universal consensus of opinion of all reputable obstetricians, and they are directly at variance with the above defence.

It may be admitted that if the membranes are ruptured abortion is practically certain, but this does not invalidate the positive fact that rupture is not indispensable for abortion to occur.

(b) **Unskilled—leaving traces.**—It is usually assumed that it is impossible for a woman to induce abortion by instrumental means upon herself. Evidence is given below that such is not necessarily the case, but for all that it is the rule that at least a second person is concerned. When such second person is a medical man, the very fact of injuries being found argues want of skill, or secrecy and haste, and suggests an evil intent, though such must not be taken for granted, for when the operation is legitimately undertaken slight lacerations may occcur, and if the woman gets impatient, as they often do, even a skilled person is liable to get flurried, and puncture the cervix, vagina, or uterus in his anxiety. Such traces of violence must not therefore be taken to *prove* criminality till all the circumstances have been investigated, however much they may suggest it.

Still, even a medical man does sometimes produce injuries which cannot be accounted for on any innocent hypothesis.

In *R.* v. *Stadtmühler* (Liverpool Winter Ass., 1858) a German doctor was charged with murder. A healthy young woman, æt. 22, consulted the prisoner in reference to her pregnant state. He employed instruments for the purpose of procuring abortion. She died within forty-eight hours, and on inspection severe internal injuries were found, which quite accounted for her death.

An important case of this kind was the subject of a criminal trial in Scotland in 1858 (case of *Reid*, *Med. Gaz.*, 1858, 2, p. 605).

The uterus near its mouth presented two openings in its substance, described as punctured wounds by the medical witnesses for the prosecution who made the examination, and as the openings of torn blood-vessels by others who were called for the defence. There was also a rupture of one ovary. The prisoner was convicted; but the medical man who was supposed to have been the principal agent in the crime committed suicide.

The case is chiefly important in showing that any apparent mechanical injury to the womb should be minutely examined at the time of inspection, so that no doubt of the cause may afterwards be entertained.

If the second person be not a medical man, but some ignorant quack, the evidence of *criminal* violence is usually much stronger, for the nature of the wounds generally shows a total lack of knowledge of the proper methods, and forbids even the supposition of justifiable attempts at relief.

The professional abortionists of India, the native *dhaees*, who are women of the lowest castes, generally adopt the following method of procuring abortion. They insert into the uterus a twig of a tree about six or eight inches long, smeared with assafœtida. The membranes are ruptured, abortion takes place, and if the woman dies from peritonitis, the walls of the uterus will usually be found perforated. It is a common practice in these cases to refer death to snake-bite, in order to prevent inspection of the body, which generally reveals the means by which the abortion was procured.

A case was tried some years since, in which the evidence showed that the prisoner had attempted to produce abortion in the deceased by thrusting wooden skewers into the substance of the uterus. Inflammation and gangrene took place, and the woman died. The prisoner was convicted, and executed for murder. (For a similar case by M'Pherson, see *Med. Gaz.*, vol. 36, p. 102; see also another case in the same journal, vol. 45, p. 693.)

In 1896 the editor had a case in the London Hospital in which the bladder had been perforated by an abortionist. The criminal was never detected. Cases of this kind might be multiplied *ad nauseam.*

The following, known as the West Houghton case (*R.* v. *Buckley*), occurred in 1894, and presents some unusual features:—

It was tried before Mr. Justice Wills and a special jury, at Liverpool Assizes, November, 1894. The prisoner, Joseph Buckley (38) of Dicconson Lane, West Houghton, was charged with the wilful murder of his wife, Sarah Buckley, aged about 42. Dr. Doman's account of the evidence is as follows:—

I was called to the house of a Mrs. Latham, where I found the deceased lying upon the sofa in the kitchen. I understood from those present that she had run from her own house to that of Mrs. Latham (a distance of two hundred yards or so) in her night attire to escape a renewal of her husband's violence. After consultation with Dr. Cooke, I made an examination of the deceased. She was dressed in her night clothes. I found there was slight hæmorrhage from the vulva; the inside of vagina had blood trickling down, and contained a few dark-coloured clots: the patient complained of great pain in the abdomen, and was suffering from shock to the system. I made repeated examinations to ascertain if she were in labour; there were, however, no signs of commencing labour, and the membranes were intact; the mouth of the womb was patulous. A midwife in attendance informed me that the patient "was expecting confinement in a week." Dr. Cooke recommended the removal of the patient to the workhouse hospital, which is six miles away. We both considered the patient was in a fit state for careful removal. Afterward, and in the presence of prisoner, I said to deceased, "Your husband is here; tell me, what has he done to you?" She replied, "He threw me on the bed, and put his hand in me, many a time." Prisoner replied, "It's all lies." The patient was dressed, and carefully transferred to a trap, and removed to her brother's house. During the remainder of that day I saw the deceased five times. The hæmorrhage had ceased, but patient was very weak, suffering from shock and collapse; there was no sign of labour. I saw her again twice on the 31st of October, and again at 2.30 p.m., when she had slightly rallied, but later on she had sunk again, and about 7 p.m. I called in Dr. Tyndall, of West Houghton, in consultation, when the collapse was greater than before. We both made examination, and this was the first time at which suspicion of a rupture through the upper part of posterior wall of vagina was entertained; but we could not, owing to the tenderness of the parts and the weak condition of patient, make a more thorough examination. At 10 p.m. I found her (with Dr. Tyndall in consultation) to be in a dying condition. I sent for Mr. George Caldwell, J.P., and in the meantime administered hypodermic injections of ether and brandy, as a result of which the patient partially revived, and the magistrate and myself put questions to her, the answers to which I wrote down on paper, and the following is a copy:—"Has kicked her on the privates, knocked her on bed, made her get up, and kicked her; put his hand inside her three or four times, struck her face, says he was drunk. Had been drinking long; said he would knock her head off. Had often ill-treated her before. He condemned her of another man. He said he could do it as well as any man or woman, but for folk talking." To the question, "Did he want to bring on confinement?" she answered "Yes." "In fear of death she adhered to truth of statement. All she has said is quite true. He actually put his hand in her body five or six times."

As the patient was actually dying, myself and Dr. Tyndall made efforts, in the interests of the unborn child, to deliver, but the patient shortly died, and we desisted.

Autopsy showed the following appearances:—

Externally.—There were no external marks of violence about the genital organs, but the right upper eyelid was blackened by ecchymosis.

Internally.—The outer surface of the uterus showed very distinct signs of acute inflammation. The intestines formed an arch over the uterus, and thus were supported. The uterus was opened by a longitudinal incision and contained a female fœtus of complete gestation, the placenta was situated on the anterior uterine wall. The head of fœtus was the presenting part. The interior of uterus showed the same signs of inflammation of its surface as did the outer surface. The os uteri was slightly dilated, and its margins presented a sloughy and uneven condition. The upper part of the posterior vaginal wall at its junction with the cervix uteri was ruptured, the aperture being sufficiently large to admit a man's hand or fist, and communicating directly with the general abdominal cavity. The rupture, in our opinion, was caused by the insertion of a foreign body with appreciable force. The peritoneal cavity contained a quantity of serous fluid, there was evidence of inflammation of the bowels situated in the lower part of abdominal cavity. The other organs of the body were healthy.

In our opinion the cause of death was metritis and slight peritonitis (caused by the rupture described) with hæmorrhage and shock to the system.

For the defence counsel argued that death was accelerated by the journey in the trap, and that delivery ought to have been effected at once, but this was swept aside by the judge, though a medical man was found to support it.

A somewhat similar case is recorded by Tardieu, "L'Avortement," p. 157.

The following case shows well the extreme injury that may be inflicted in attempts to procure abortion; the defence, though successful, would probably not again be so:—

R. v. *Westworth*, Liverpool Assizes, March, 1896. The facts ascertained at the trial were these: The prisoner's wife had been married to him for eight years, had borne three children, and was sworn to have said that "she would rather kill herself than have another," but there was no evidence to prove that she believed herself to be pregnant at the time of her death, though there was evidence suggesting that she thought so in October, 1895. On the night of the 12th December, 1895, the prisoner stated that he arrived home about midnight and found his wife lying on the sofa in the parlour, as he thought, drunk, and bleeding from the vagina; he immediately fetched a doctor, and with his assistance carried her upstairs to the bedroom, where she died next morning. The post-mortem examination of the body was made by Drs. Gordon, Paul, and Barnes, in the presence of Dr. Mulliner, on December 14th, 1895, when the following pathological appearances were noted:—(1) Between forty and fifty small bruises on the legs and arms, which Dr. Paul swore were so situated—other accounts say on front and inner side of the thighs, and a large one on the hip—that they could not have been produced by falls, nor by the victim herself; (2) four wounds in the vagina: of these one was about half-an-inch deep, just inside the vaginal orifice, near the urethra, a second of about the same depth was an inch higher up, also on the front wall of the vagina, a third at the left-hand top corner of the vagina, penetrating the left broad ligament, causing much extravasation of blood, but not penetrating the peritoneum; a fourth, much larger than the others in calibre, passed out of the vagina between the uterus and bladder into the peritoneal cavity, it then penetrated the tissues in front of the spine, ran alongside the aorta, entered the peritoneum again near the left kidney, twice perforated the mesentery of the top of the jejunum, and passed through the left kidney; a second plunge, apparently through the larger hole in the vagina, had sent the instrument up to the pyloric end of the stomach, which was bruised but not perforated. The deceased was found not to be pregnant, and the uterus was quite healthy. (This account is taken from the *Lancet*, vol. 1, 1896, p. 860, which, in turn, was taken down from Dr. Paul's words *verbatim.*) Paul, with Gordon and Barnes, held that the bruises could only have been caused by some heavy instrument, such as the round head of a poker, as, though most of them were small, they penetrated deeply into the muscles; they also held that it was physically impossible for such internal injuries as those described to have been self-inflicted. Whitehead, of Manchester, Bennett, and Mulliner on the other hand held that the bruises might have been caused by the efforts of Gordon and the prisoner in carrying the deceased upstairs, and that the internal injuries might have been self-inflicted from behind whilst the victim was lying on the sofa. A small brass poker with blood on the handle was found in the room, and was alleged to be the weapon with which the above wounds were inflicted. On being asked his reasons for saying that the internal wounds could not have been self-inflicted, Mr. Paul is reported as saying "They were so extensive that I cannot believe that any human being could inflict such wounds on herself," and "The instrument must have been introduced from behind," and further, "The wounds are such as we have no previous experience nor knowledge of," "There are limits to human power, and I think this is beyond human power." He admitted that, "Supposing the woman had been using the poker from behind and slipped, sufficient force might have been occasioned to cause the wounds."

In face of a verdict of acquittal, which the jury pronounced after very short consultation, criticism is powerless, but we may hope that such injuries may long remain unique.

Local Injections.—A case occurred in France in which it was proved that abortion had been caused by the injection of some corrosive and irritating substance into the vagina. The genital organs, as well as the abdominal viscera, were found in a high state of inflammation (*Med. Gaz.*, vol. 37, p. 171). This is an unusual mode of perpetrating the crime, but it is one which can hardly escape detection. An analysis of the tissues might be required, in order to determine the nature of the substance used. It appeared from a trial which took place (York Sum. Ass., 1853), that this mode of attempting to procure criminal abortion has been the subject of a prosecution in this country. It was established by the evidence that some liquid was injected into the vagina by a syringe, but there was no proof of the nature of this liquid; and as it was not shown to be of a *noxious* nature, the judge who tried the cause directed an acquittal (*Lancet*, 1853, 2, p. 89). The mere mechanical effect, however, of an innocent liquid frequently applied may be more effectual in producing abortion or premature labour than the use of any irritating liquid. In medical practice, tepid water has been employed as an injection for the purpose of inducing premature labour. Lazarewitch has published twelve cases in which the injection of water at 95° F. caused the uterus to contract and expel its contents ("Trans. of the Obst. Soc.," vol. 9, p. 161). The earliest period at which Lazarewitch employed water was in the thirtieth week of pregnancy. In most of the cases the women had reached the thirty-sixth week of pregnancy. This is much later than the usual period at which abortion is commonly attempted for criminal purposes, namely, about the twenty-eighth week. At the same time it proves that an innocent injection may be used to produce abortion. The words of the statute, however, "other means whatsoever," appear sufficiently comprehensive to include the use of a non-noxious liquid, and according to a judicial opinion given in the case of Wallis (*R.* v. *Wallis*), it is not material to prove that the liquid employed is *per se* of a "noxious" nature.

In the case of Collins (*R.* v. *Collins*, reported in full, *B. M. J.*, 2, 1898, p. 59) there was some evidence to suggest that he had used injections of corrosive sublimate to effect his purpose. This substance might be chosen in false reliance upon its undoubted antiseptic powers.

Self-Induced Instrumental Abortion.—The following case serves to emphasise the possibility of self-induced instrumental abortion, and the care necessary in dealing with such cases in private to protect oneself against, at least, the suspicion of malpractice.

"A married woman with several children sent for me to visit her, and gave the following history: She knew herself pregnant, having gone several days over her time; since then (several weeks) she had been losing blood constantly. On examining her the cervix was found soft and patulous, with blood escaping from it, and the uterus irregularly contracted, apparently about the size of the pregnant uterus at four months. She had no fever, pain, nor tenderness.

"On further questioning her, she at first admitted taking 'herbs'; then that she had 'scraped out the womb with a hairpin,' shewing me the pin, which was an ordinary woman's hairpin, the looped end of which she had used as a 'curette,' the operation being rendered easier by her suffering from slight prolapse, and pressing on the fundus through the abdominal wall. She informed me that she had done the same thing twelve months ago, with the result that in the course of time she was delivered of what seems to have been a fleshy mole. She informed me that she had told no one but myself of the cause; and, with the possibility of complications in view, I decided to send her to hospital. Through the courtesy of the house-surgeon I am able to state that after a course of ecbolic medicine she was delivered of a fœtus of about five months' gestation, which appeared to have been some time dead, and the patient progressed satisfactorily. I am induced to chronicle the above case on the following grounds :—

"1. It has been frequently stated that self-induced instrumental abortion is impossible.

"2. A practitioner would be placed in an awkward position if, when called to treat such a case, peritonitis and a fatal ending should supervene, he probably not knowing the actual cause.

"3. If a post-mortem were made and a wound found, what would be the inference?" (*B. M. J.*, 2, 1899, p. 187.)

In the *Lancet*, 2, 1900, p. 978, the following note occurs :—

An inquest was held in Bath on September 20th upon a married woman aged thirty-six years. It was proved that deceased had taken drugs and used an instrument upon herself for the purpose of procuring a miscarriage. Medical evidence showed that the drugs were harmless, but that the deceased had used an instrument. The coroner said the woman had paid the penalty of her own foolish act and evidently nobody else was implicated. The jury returned a verdict of "Death from septic poisoning."

Within the editor's personal knowledge a girl confessed that she had pushed the handle of a small paint brush up the womb till she "felt something give way"; abortion had resulted.

A curious case was tried some years ago in which a **vaginal speculum** figured prominently; it need not be remarked that no medical man who wished to induce abortion would ever make use of such an instrument; though it is conceivable that in an unhealthy uterus such vaginal manipulation might possibly cause the event, it would be to the last degree improbable that a healthy uterus would empty itself upon such provocation. But for all that, when this instrument has been improperly or unnecessarily used on a pregnant woman, a charge of attempted abortion by instruments may be easily raised against a medical practitioner.

The trial above referred to took place at Exeter Lent Assizes, 1844 (*R.* v. *Griffin and Venn*). According to the evidence, Venn had on several occasions passed a round polished instrument into the body of the woman, once in a coppice and at another time in a field. The defence was that the surgeon had merely used a speculum to ascertain whether she was pregnant, in order to know how to prescribe for her; and that it was absurd to suppose that he had ever intended to procure abortion, for this had not followed, and it might have been easily induced by him at any period of pregnancy if he had wished it. The prisoners were acquitted. Admitting the statements of the prosecutrix and prisoner to be correct, it may be remarked that it is a well-known fact that a speculum is not required for determining the question of pregnancy at all.

B. Production of Abortion by Drugs.

The following generalisation, which is strictly warranted by facts, conveys a warning to would-be abortionists, whether professional and habitual, or lay and occasional—THERE IS NO DRUG AND NO COMBINATION OF DRUGS WHICH WILL, WHEN TAKEN BY THE MOUTH, CAUSE A HEALTHY UTERUS TO EMPTY ITSELF, UNLESS IT BE GIVEN IN DOSES SUFFICIENTLY LARGE TO SERIOUSLY ENDANGER, BY POISONING, THE LIFE OF THE WOMAN WHO TAKES IT OR THEM.

Notwithstanding this very serious statement abortionists still exist, and we must consider what drugs they use. For the actions of the drugs mentioned, and for much other information, the editor has largely to thank the *Lancet*, vol. 2, 1898, and vol. 1, 1899, wherein the reader will find a series of articles on "Quacks and Abortion," giving much valuable information as to the *modus operandi* of these creatures.

"The action of emmenagogues and ecbolics is a difficult question to decide, and one upon which very little experimental work has so far been done. The conclusions as to the action of certain drugs rest almost entirely upon clinical evidence often of very doubtful value. Emmenagogues may be defined as remedies used to produce or increase the menstrual flow. They may be divided into direct and indirect; the former are supposed to act directly upon the uterus or the nervous system in close relation to it, while the latter act by promoting or restoring the health of the body as a whole.

Indirect emmenagogues include, therefore,

Tonics, such as iron and arsenic;

Hæmatinics, especially iron; and

Purgatives, especially of the stronger kind such as colocynth, gamboge, magnesium and sodium sulphate, and aloes, croton oil, elaterium, hiera picra (a mixture of aloes and canella bark), and pilacotia (a mixture of aloes and colocynth).

Amongst direct emmenagogues the following drugs have from time to time been included: aloes, cantharides, caulophyllin, borax, apiol, cimicifuga racemosa, potassium permanganate, manganese dioxide, myrrh, anemone pulsatilla, polygala senega, sanguinarin, pennyroyal or mentha pulegium, senecio, yew leaves, grains of paradise, tansy, hellebore (white and black), squills, broom, male fern, laburnum, asarum arabicum.

Ecbolics may be defined as drugs increasing the expulsive power of the uterine muscle. Commonly included amongst this class are ergot, hydrastis canadensis, ruta, juniperus sabina, quinine, and sodii salicylas, although this is rather an emmenagogue than an ecbolic."

In addition to this list from the *Lancet* a few metals must be included, lead especially, and also mercury.

According to Dr. Stevenson's experience, a mixture of the watery extract of aloes and ferric chloride in large doses is a favourite abortifacient among abortion-mongers. Should this fail of its effect, ergot is given at a later stage of pregnancy; and if this also fails to secure the desired result, instrumental means are employed.

The native Indian abortionists employ the following drugs: camphor, the juice of the jaeta, the mulberry, and seajeenaroot, as well as pan root—a species of pepper. These act chiefly as irritants upon the system, although they are supposed to have a specific effect on the uterus as ecbolics.

Vegetable Abortifacients (?).—The article in the *Lancet* then proceeds:

"We will now consider the respective action of these drugs in detail.

Aloes apparently acts by producing congestion of the large intestine and of the pelvic organs. It is said to have a direct effect upon the uterus, but there is no exact evidence of this.

Cantharides has less effect upon the genito-urinary organs of women than upon those of men. It has no special effect upon the uterus, but has, however, caused abortion in large doses, although one drachm has been taken by a pregnant patient with no effect. It would produce abortion only in large doses, and then only by its action as an irritant poison. We have not been able to find any experimental evidence as to its abortifacient powers.

Caulophyllin, from Caulophyllum thalictroides, a resinoid powder obtained from the root.—This principle is said to have a direct influence upon the uterus or upon the motor nerves supplying the uterus. It has been used in America for the purpose of producing abortion with apparent success. The dose of caulophyllin is given in Martindale's Extra Pharmacopœia as from one to four grains, but the dose necessary to procure abortion is not definitely known.

Borax.—This is used clinically for amenorrhœa, but no evidence exists of its possessing a definite effect upon the uterus.

Apiol.—The neutral principle of petroselinum sativum or common parsley has a decided action as an emmenagogue. In doses of from three to five minims three or four times a day it is said to have no abortifacient effect whatever. Perhaps larger doses might produce such an effect.

Cimifuga racemosa.—This drug is said to act upon the uterus and to cause uterine contraction, but we have been unable to find any experimental evidence in support of this. It has been used to promote contraction of the uterus and to hasten expulsion of the placenta. It might help to produce abortion.

Potassium permanganate and Manganese dioxide.—The clinical evidence as to the value of these salts as emmenagogues is conflicting. In ordinary doses they do not tend to produce abortion. Cases of abortion occurring after the administration of potassium permanganate are recorded, but it is doubtful whether this result was not due to the general condition of the patient apart from the drug.

Myrrh.—This is said by Cullen to act directly upon the uterus, but Sydenham denies this. If it has any action it is feeble and probably indirect rather than direct. It acts as a stomachic tonic. We have not found any experimental evidence as to its abortifacient or emmenagogic powers.

Anemone pulsatilla.—There is clinical evidence to show that this drug is useful in amenorrhœa. It has an irritant effect upon the kidneys and digestive tract.

Polygala senega.—This is used in the United States as an abortifacient apparently with success. But the dose is uncertain and there is no definite evidence either clinical or experimental as to its action upon the uterus.

Sanguinarin.—A resinoid powder obtained from the blood-root (sanguinaria canadensis). This is said to be an emmenagogue.

Pennyroyal, Mentha pulegium.—This is a popular emmenagogue and abortifacient, but is, we believe, never used at the present day by medical men. It has neither emmenagogue nor ecbolic properties, and is not now employed for any purpose by medical practitioners. It is a warm stomachic, like the other mints, and its place in pharmacy is now supplied by peppermint water."

Any notice of this substance here would have been quite unnecessary, but for the fact that in a trial for criminal abortion (*R.* v. *Wallis*, 1871), strongly abortive properties were incorrectly assigned to it; and it was described as a highly noxious substance.

A solicitor was charged with administering, or causing to be administered, to a lady pregnant by him, certain noxious drugs, namely, the infusion of pennyroyal and a quantity of "Griffiths's mixture," with intent to procure abortion. The evidence showed that the prisoner had procured from a druggist the two substances mentioned, and had handed them to the lady. She subsequently had a miscarriage, and the prisoner was present soon after the delivery, but the body of the child was not forthcoming. The lady had reached the sixth month of her pregnancy, and prior to the miscarriage there were no urgent symptoms of vomiting, purging, or pain, such as irritant substances given for the purpose of exciting abortion commonly produce. She soon recovered without any bad symptom. There was nothing to show that mechanical violence had been used or drugs of a powerful kind taken by her. She had been in the habit of taking horse-exercise up to almost the date of the miscarriage; and it was alleged for the defence that at this time she had met with an accident or had sustained a shock while riding, which might account for the premature confinement. It was proved that the prisoner had procured the leaves of pennyroyal, and also a bottle of a compound of iron and myrrh called Griffiths's mixture, assigning an untrue reason for procuring them, and had handed them to the lady. The medical evidence at the trial chiefly turned upon the question whether pennyroyal and Griffiths's mixture were such substances as would procure abortion. Some medical witnesses called for the prosecution deposed that they would; others said that they would not act on the uterus to expel the contents. The prisoner was acquitted of the charge of administering the drugs. The remarkable part of this case is the conflict of medical opinion on the properties of such substances as pennyroyal and Griffiths's mixture. With regard to this mixture there is no instance recorded of its having had any effect on the uterus of a pregnant woman as an abortive; and there is nothing in it which could lead to such a result. Griffiths's mixture has long been used in medicine as a chalybeate tonic. It is a saccharine ferrous carbonate, having no action on the uterus as an ecbolic, although often given to women not pregnant as an emmenagogue. A small dose would do no injury, but a large dose might cause nausea and vomiting. In this case the prosecutrix was called as a witness, and she stated that Griffiths's mixture had been procured for her by the prisoner at her request. She had copied the formula from a medicinal book. She had taken only two doses of it, but had taken none of the pennyroyal which had been provided in the state of leaves.

The counsel for the prosecution stated that the iron and myrrh contained in Griffiths's mixture were "clearly abortive in their character"; and that the pennyroyal infusion was "sufficient to procure abortion." The medical evidence adduced to support this statement broke down on cross-examination, and was directly contradicted by the evidence of Hicks, Tyler Smith, and Barnes. They all agreed that Griffiths's mixture was a good iron tonic, that it was not an abortive, and in the small quantity taken by the prosecutrix could have had no effect in causing abortion in this case. They also stated that pennyroyal was not a noxious substance, although classed by some writers as an emmenagogue, and probably used for the purpose by ignorant women; it had no effect in producing abortion. Some confusion appears to have arisen in this case respecting the meaning of the term emmenagogue. It was evidently treated by some of the witnesses as synonymous with ecbolic or abortive, whereas its signification is widely different.

"*Senecio.*—According to Fothergill and Murrell this drug is an emmenagogue but not an ecbolic, at any rate in ordinary doses. It has a definite action in cases of amenorrhœa.

Ergot.—As to the action of ergot there can be no doubt that it is a *true ecbolic.* The action upon the muscular tissue is mainly due to the cornutine and sclerotic acid it contains. It produces powerful uterine contractions, and although it acts best when uterine action has started, yet given in a fair dose at the time when the menstrual periods should occur it would be likely to initiate uterine action and so in a case of pregnancy would act as an abortifacient."

In powder, infusion, or tincture, it has been for some time used by medical practitioners to excite the action of the uterus and aid parturition. It is also used for a similar purpose on animals in veterinary practice. A trial which took place at the Central Criminal Court in July, 1871, shows that "herbalists" are well acquainted with the properties of ergot as an abortive, and are ready to supply it in secrecy (*R.* v. *De Baddeley and wife*). The prisoners in this case gave ergot of rye, knowing that it was intended to procure abortion.

An advertisement was inserted in a spiritualistic journal inviting people to consult at that house "Madame De Baddeley, the celebrated clairvoyante." From what was alleged to be transacted there, the police were induced to send a woman to consult the prisoners, and to concoct a story which might elicit their "spiritual" mode of procedure. After being put into a state of so-called "clairvoyance," the female prisoner advised the applicant what to do in the case of a young woman whom she had mentioned, and gave her a quantity of ergot of rye to procure abortion. In all, 6*l.* was paid to the prisoners. The drug was at once handed over to the police. They were found guilty.

Ergot of rye has been found to bring on contractions of the uterus at an advanced stage of gestation, or when efforts at parturition had already commenced. There is, however, some difference of opinion respecting its exact mode of action, whether, that is, it acts directly on the muscle fibre or indirectly through centres and nerves (Hale White, "Therapeutics").

Eden, "Pract. of Midw.," 1908, states very plainly—ergot in any dose is unable to transform the contractions characteristic of pregnancy into those characteristic of labour: it is therefore useless for inducing abortion or premature labour, and its specific effect is manifested only on the parturient uterus.

A case occurred at Brighton, in 1864, in which a question arose respecting the fatal effects of ergot on a woman who had taken it for a long period, obviously with a view to procure abortion. She died, however, without abortion having taken place; and the question at issue was, whether this drug had or had not caused her death. The dose taken was about a teaspoonful of the tincture of ergot three times a day, for a period of eleven weeks. On inspection, patches of inflammation were found on the mucous membrane of the stomach after death. No other cause for death was apparent, and one medical witness assigned it to the poisonous irritant action of the ergot, as, at the early stage of pregnancy which she had reached (the third month), this substance would not be likely to act as an abortive. Another medical man who gave evidence at the inquest, asserted that death could never be primarily caused by ergot of rye. The qualification introduced into this medical opinion is of small importance. The deceased woman is reported to have taken a large portion of the tincture, and it is immaterial whether the drug killed her by a primary or secondary operation. Tardieu describes the case of a woman, æt. 24, who aborted in the fourth month of pregnancy, as a result of the administration of ergot in powder; she died from peritonitis in about twenty-four hours. The ergot was found in fragments in the lower third of the bowels ("Ann. d'Hyg.," 1855, vol. 1, 404).

In 1878, a woman was tried (*R.* v. *Brown*, Lewes Ass., June, 1878) for administering ergot to a married woman with the view of procuring abortion. There was little doubt that ergot was the substance administered; and though repeated doses were given, the drug failed of its effect.

The case broke down, the only evidence being that of the patient herself, and Thesiger, L.J., directed an acquittal on the ground that the woman to whom the drug was given by consenting to the operation made herself an accomplice; and it is a maxim of English law that no person can be convicted of a criminal offence on the unsupported evidence of an accomplice.

For actions and symptoms other than ecbolic, *vide* Sect. XVI., "Poisoning by Ergot."

"*Hydrastris Canadensis.*—This causes contraction of the peripheral blood-vessels, and acts upon the uterine muscular tissue. It has a direct effect upon the muscular fibres of the uterus due to the hydrastine or hydrastinine it contains. In one case, 17½ grammes of hydrastine in five days brought on labour at the seventh month. It is of very little use as an emmenagogue, but is a definite ecbolic, and therefore might produce abortion.

Nutmeg Myristica Fragrans.—This common kitchen flavour has some reputation amongst ignorant people as an abortifacient; needless to say, no such action is known to the profession." For cases and symptoms *vide* Sect. XVI., "Poisoning by Nutmeg."

"*Ruta.*—There seems to be no doubt that given as infusion or as oil this produces emmenagogic and ecbolic effects, acting possibly directly upon uterine muscular tissue or through the nervous system. Experiments upon rabbits by Hamelin show this. The exact dose necessary to produce abortion in the human female is not certain. The drug is often taken as an infusion, and it probably has a direct action upon the uterus, and does not act merely as a gastro-intestinal irritant."

This common garden plant has been much used in the form of decoction. Tardieu reported three cases in which a strong decoction of rue produced abortion at the fourth, fifth, and about the sixth month of pregnancy respectively, and the women recovered ("Ann. d'Hyg.," 1855, 1, 403). Among the symptoms caused by rue when taken for the purposes of abortion are profuse salivation and great swelling of the tongue. Abortion has slowly taken place after five or six days. There has been no inflammation of the uterus, but the woman has not recovered from the effects for a long time (Horn's *Vierteljahrsschr.*, 1866, 1, 233). Rue acts most powerfully when taken in the fresh state. The active principle appears to be a volatile oil, which gives the peculiar odour to the plant. The oil is most abundant in the seeds. In the event of the leaves being taken, the best evidence will be furnished by their botanical characters.

Savin, Juniperus sabina.—Hamelin made some experiments on a rabbit, and produced abortion without any definite suffering on the part of the animal.

The rabbit, weighing 2 kilos. 300 grammes, was given in four doses on different days, some 70 c.c. of an infusion of fresh savin tops and 20 minims of the oil. Another treated in the same fashion died from inflammation of the lungs and abdominal viscera without aborting. A bitch went to term without aborting, although suffering from severe gastro-intestinal disturbance produced by the drug. In this case the animal weighed 7 kilos. 500 grammes, was in the fourth week of gestation, and was given during three weeks six large doses of a fresh infusion and full doses of the oil.

Savin is reputed to have an emmenagogic action, but it is exceedingly doubtful if it has any direct effect upon the uterus. It is employed as a popular abortive. In small doses it is useless, while in large doses it acts as an irritant poison. The woman may die undelivered or the fœtus may be expelled, and the mother subsequently die from the effects of the drug.

The fatal irritant action of savin will be evident from the following case. In 1845, the deceased, a healthy woman, had reached about the seventh month of pregnancy. She was very well on the Friday, but was seized with vomiting on the Saturday, and she stated that she had taken nothing to produce this. The vomiting continued throughout Sunday, and was of a green colour. She was first seen by a medical man on Sunday evening. The symptoms were those of inflammation of the stomach and bowels, with great anxiety: pulse 150. The green colour of the vomited matter was at first supposed to be owing to bile. The vomiting appears to have continued at intervals, but it does not seem that there was any violent purging. Labour supervened on Wednesday. The child was born living, but soon died. The woman died on the Thursday, *i.e.*, five days after having taken the poison, for there was no proof that any savin could have been taken after Saturday. The brain and lungs were healthy, except that the air-tubes had a dark red colour; the heart was flabby; the blood was generally fluid. The lining-membrane of the gullet was reddened, and had on it ecchymosed patches. Half of the mucous membrane, from the cardiac orifice upwards, presented a dark red arborescent injection, with slight patches of ecchymosis; but there was no erosion or ulceration. In the stomach a large patch of redness, about three inches in extent, extended from the greater curvature towards the pylorus. The vessels of the mucous membrane were considerably injected, forming infiltrated patches, especially about the lesser curvature, extending towards the cardiac end; but there was no ulceration or erosion. The stomach contained nearly eight ounces of a greenish fluid, of the appearance and consistency of green-pea soup. By examining a portion of the washed vegetable substance under a microscope, and by drying a portion, rubbing it, and observing the odour, clear evidence was obtained that the green colour was owing to the diffusion of finely triturated savin powder (*vide* Section XVI.). The interior of the duodenum, especially towards the pylorus, was intensely inflamed, being of the colour of cinnabar. Patches of inflammation were found throughout the other portions of the intestines. There was some inflammation of the peritoneum, chiefly of the upper part of the intestines and omentum. The kidneys were inflamed, and of a dark red colour; the bladder was healthy. Green-coloured mucous matter, containing savin, was found in the duodenum, but not in the lower part of the intestines (*Med. Gaz.*, vol. 36, p. 646). The quantity of poison taken by the deceased could not be ascertained, but it must have been large. The quantity remaining in the stomach after five days, under frequent vomiting, was from twenty-five to thirty grains.

In another case a pregnant female, eight hours after she had taken savin, was found lying on her back, perfectly insensible, and breathing stertorously. She had been suddenly seized with vomiting, and this continued for some time. At first the case was thought to be one of puerperal convulsions. Labour came on, and she died in about four hours, during a fit of pain. She appeared to be between the seventh and eighth month of pregnancy, and the child was born dead. On inspection, twenty-four hours after death, the brain was found gorged with black fluid blood. The stomach was paler than usual, excepting in one or two spots, which were red, as if blood had been effused into the mucous tissue. It contained four ounces of an acid liquid of a brownish-green colour. This, on distillation, yielded an opaque liquid, from which a few drops of a yellow oil were separated by means of ether. Some sediment found in a bottle presented, under the microscope, the characters of powdered savin (*Lancet*, June 14th, 1845, p. 667). There can be no doubt that this substance was the cause of death. The action of the poison appears to have been, in the first instance, like that of an irritant, and just before death like that of a narcotic.

The symptoms are not always those of an irritant. In some exceptional instances, as in the subjoined case, the action of the poison was spent on the nervous system:—

A young woman, advanced to the eighth month of pregnancy, secretly took this substance for an abortive. A medical man who was called to see her found her with the teeth tightly clenched, and unable to swallow. There were tetanic convulsions, and the body was slightly arched forwards. She died, as was at first supposed, from strychnine poisoning; but on examining the contents of the stomach, as well as a bottle containing a mixture, part of which she had taken before death, Tidy found a large quantity of savin (from the effects of which there was no doubt she had died), but no strychnine (*Lancet*, 1872, 2, p. 41).

It will be seen, therefore, that under a fatal dose of this drug, sufficient to act as a special poison, a woman even advanced so far as the eighth month of pregnancy may die without any effect being produced on the womb.

The powdered leaves are the form in which savin has been often given as a popular abortive, and the above cases show the dangerous effects to the woman and child. The leaves of savin are readily obtainable in gardens. They may be given in the form of infusion or decoction. The former is the most powerful. Savin may also be given as a tincture, or as an essential oil. In all these forms, in large or frequently repeated doses, it has an irritant action. The powdered leaves are not used in medical practice. The dose as an emmenagogue would be from five to fifteen grains—the medicinal dose of the oil is from two to six minims, and of the tincture (*Tinct. Sabinæ*, now expunged from the Brit. Pharm.—Ed.) is from twenty minims to one fluid drachm. This holds the oil and resin dissolved. The leaves of savin may be identified by their peculiar odour when rubbed, and also by their appearance under the microscope.

Cases in which the oil of savin has been administered for the purpose of abortion are common.

In *R.* v. *Pascoe* (Cornwall Lent Ass., 1852) a medical man was convicted of administering oil of savin to a woman with intent to procure miscarriage. The proof of intent rested partly on medical and partly on moral circumstances. It appeared that the prisoner had given fourteen drops of the oil, divided into three doses, daily—a quantity which, according to the medical evidence at the trial, was greater than should have been prescribed for any lawful purpose.

On the Northern Circuit, December, 1853 (*R.* v. *Moore*), a man was tried and convicted of administering oil of savin to a pregnant woman. It made her very ill, but did not produce abortion.

The *oil of savin* is obtained in the proportion of 2 or 3 per cent. by weight by the distillation of the tops. It has a yellowish colour, and the peculiar terebinthinate odour of the plant, by which alone it may be recognised. It may be separated from the contents of the stomach by agitating them with its volume of ether, in which the oil is very soluble. The ether may be afterwards removed by distillation. The odour of the oil is stated to have been perceived in the blood and in the cavities of the body. This may be regarded as the best test of its presence (Horn's *Vierteljahrsschr.*, 1866, 1, 241). The oil of savin forms a turbid mixture with alcohol. When treated with an equal volume of sulphuric acid it acquires a dark brown colour, and when this mixture is added to distilled water, a dense white precipitate separates.

Tanacetum vulgare. Tansy. Oil of tansy.—Hartshorne states that in the United States the *oil of tansy* has acquired the character of a popular abortive, and has caused death in several instances. In

England this oil, and the herb, have been chiefly employed for the purpose of expelling worms. Pereira quotes a case in which half an ounce of the oil proved fatal. The symptoms were spasms, convulsive movements, and impeded respiration; no inflammation of the stomach or bowels was discovered upon dissection. The cases referred to by Hartshorne are—

1. A teaspoonful of the volatile oil was taken by a girl in mistake for the essence. She complained of giddiness, and became insensible in ten minutes; convulsions came on, with frothing at the mouth, difficult respiration, and irregular pulse; and she died in one hour after taking the oil (*Amer. Jour. Med. Sc.*, July, 1852, p. 279). 2. The second case occurred to Dalton, and is reported by him in the same Journal for January, 1852, p. 136. A healthy-looking girl, æt. 21, took eleven drachms of oil of tansy about six hours after a hearty dinner. She was found insensible, and in convulsions, soon after she had taken the drug. She died in three hours and a half. A strong odour of tansy was observed in the breath before death, and on inspection in the peritoneal cavity, stomach, and even the interior of the heart. The uterus contained a well-formed fœtus about four months old, which did not, either in itself or its membranes, present any evidence of having been disturbed. 3. In a third case (*Amer. Jour. Med. Sc.*, May, 1835, p. 256), a woman but a few weeks pregnant took half an ounce of the oil, and did not entirely lose her consciousness until three-quarters of an hour had elapsed, although she was convulsed at intervals before that time. She died without abortion being produced, within two hours after taking the poison. (For another case see *Med. Times and Gaz.*, 1861, 1, p. 397.)

These facts show, that while oil of tansy possesses no specific action on the uterus as an abortive, and does not even affect this organ or its contents by sympathy, it is capable of acting as a powerful poison on the brain and nervous system, and of destroying life rapidly. The oil would be easily recognised, either before or after distillation of the contents of the stomach, by its peculiar and penetrating odour. It is very soluble in ether, and this may be employed for its separation.

Saffron.—A decoction of the dried stigmas of saffron (*Crocus sativus*) has been employed as a popular abortive. Thomsen has reported a case in which abortion occurred in a woman who had taken repeated doses of a decoction of saffron with starch. There was reason to believe, however, that manipulations *per vaginam* had also been resorted to, and these may have had the principal share in bringing about the result (Horn's *Vierteljahrsschr.*, 2, p. 315). According to Pereira, although saffron was formerly used as an emmenagogue and to promote uterine contractions, it is not established by any trustworthy observations that it possesses any medicinal properties. In modern medicine its chief use is to give colour and flavour to liquids. It has been observed that when administered to pregnant women, the yellow colouring-matter has been absorbed, and the fœtus *in utero* has been stained with it. This appearance in the body of the fœtus might lead to a suspicion of its use, although no injury to the woman may have resulted.

Quinine.—The definite effect produced by the administration of quinine during labour is partly due to its general tonic action and partly to a direct action upon the uterus or uterine nerves. It definitely increases uterine pains, but there is no undisputed evidence that it will produce abortion even when pushed.

Sodii salicylas.—This drug often causes hæmorrhages from mucous membranes and not infrequently brings on menstruation when given for rheumatism. This was definitely proved by a case which was under observation for two years. Apart from this tendency to produce hæmorrhage it has no action on the uterus and is not a true ecbolic. It might produce abortion but not with certainty.

Asarum Europæum Asarabacca.—The powdered leaves of this plant were formerly used in medicine. The leaves, as well as the root, are irritant and acrid, owing to the presence of an essential oil. They have an aromatic and bitter taste. In doses of from half a drachm to a drachm these preparations excite vomiting, purging, and griping pains. Like other acrid or irritant substances, they may lead indirectly to abortion by their effects on the general system, but they have no specific action on the uterus. Maschka met with the following case, in which a decoction of the leaves, taken by a pregnant woman, was followed by death without causing abortion.

A woman who had reached the fourth month of her pregnancy was advised to take a decoction of asarum for the purpose of exciting abortion. Pains in the abdomen were followed by convulsions, which proved fatal on the second day. The coats of the stomach and duodenum were found softened and reddened. The stomach contained a pasty-looking substance, without any appearance of leaves, roots, or seeds. The kidneys were much diseased, and in the uterus there was a four months' fœtus. The contents of the stomach were examined chemically, but nothing was found to throw a light on the cause of death. The fact that she had taken a decoction of asarum was rendered probable by the evidence of witnesses; but it had not produced the usual effects of vomiting and purging. Maschka ascribed death to a diseased condition of the kidneys, leading to uræmic poisoning of the blood. This had, in his opinion, caused *eclampsia gravidarum* and death. (Horn's *Vierteljahrsschr.*, 1865, 1, 54.)

In 1856, a medical man was convicted at the Central Criminal Court of Sydney of administering *extract of belladonna* as a suppository, in order to excite abortion; this substance has no influence on the uterus, except in affecting it indirectly by its action on the system.

In the *B. M. J.*, 2, 1902, the following note occurs:—

"*Oil of Absinthe as a Supposed Abortifacient.*—An inquest was recently held on the wife of a farm labourer living near Runcorn, who, according to the report in the *Liverpool Courier*, died three-quarters of an hour after swallowing over 100 gr. of oil of absinthe, which, according to the evidence, she had obtained for the purpose of terminating pregnancy. She had obtained the drug from a firm of qualified chemists in Liverpool, from whose representative it was elicited at the inquest that absinthe was not a scheduled poison, that it was not regarded as a poison, and that in this instance the dose—one or two drops—was not indicated on the bottle. From the evidence of a neighbour it appeared that the drug came by the evening post, that the deceased took it almost immediately, and that a few minutes later she was found lying speechless in the yard. The coroner expressed the opinion that it was very reprehensible for such a drug to be supplied without a direction as to the dose, and to an illiterate person as in the present case. The jury returned the verdict that death was caused through deceased taking an overdose of oil of absinthe to cause abortion, and recommended that such a dangerous drug should be scheduled as a poison. They also stated that they were satisfied it was taken by mistake; that the woman did not know the quantity. In the course of the inquiry Dr. Carter Bell, Analyst to the County of

Chester, said that he believed oil of absinthe was frequently used as an abortive: that it was one of those substances believed by the laity, and probably erroneously, to have the power of ending pregnancy seems, indeed, to be fairly certain. References to the action of the drug have been kindly supplied by Dr. R. H. Beardsley, in Stellé's *National Dispensatory* (J. and A. Churchill, 1879)."

Metals and Mineral Substances as Abortifacients.—Mineral poisons have been ignorantly employed for this nefarious object, and often with a fatal result. Among these substances may be mentioned phosphorus, arsenic, corrosive sublimate, bichromate of potassium (Horn's *Vierteljahrsschr.*, 1866, 2, 113), blue vitriol or sulphate of copper, copperas or ferrous sulphate, the preparations of ferric chloride, and other irritants. Metallic mercury, which is generally reputed to be innocent, has been given for the purpose of procuring abortion. In one case (*Lancet*, 1873, 1, p. 339), it produced no effect on the uterus, but caused some severe nervous symptoms, which would justify the application of the term "noxious" to this substance.

A man administered to a girl, æt. 20, in the third month of pregnancy, about four ounces and a half of metallic mercury. It had no effect on the uterus, but in a few days, owing to oxidation and absorption of the metal, tremors began to affect the right side of her body. Her gait became unsteady, and she stumbled in walking. These symptoms continued unabated for two months and then affected the left side. She lost the power of grasping things. She went the full time, and the symptoms had then almost disappeared.

This is perhaps the only instance in which mercury has been given by the mouth (*vide* "Injections" above) for such a purpose. These powerful poisons may produce violent symptoms and destroy life, without in any way affecting the gravid uterus or its contents. A woman, æt. 22, had passed the fifth month of her pregnancy, and died, it was supposed, from the effects of arsenic. It appeared from the evidence that, with the view of producing abortion, she had been advised to take a large dose of arsenic. She suffered from severe vomiting and purging, and died in seven hours without having aborted. A large quantity of arsenic was found in the stomach.

The Tincture of Ferric Chloride has frequently caused severe symptoms, and seriously injured health, without producing abortion.

In one case (*R.* v. *Rumble*, Lincoln Sum. Ass., 1863), it was proved that this compound of iron had been given in large doses daily to a pregnant woman, for the purpose of exciting abortion. It had no such effect. The prisoner also gave to her cantharides in pills. The defence was, that these were proper medicines for the treatment of amenorrhœa, under which it was alleged she was labouring. The large doses administered, and the secrecy with which the medicine was supplied, proved that they had been given unlawfully and with criminal intent; the druggist who supplied them was convicted.

Lead.—Dr. Ransom, of Nottingham, writing on lead poisoning, in the *B. M. J.*, vol. 1, 1900, p. 1591, after describing three cases, says:

"From my own experience, therefore, I have reason to believe that the use of diachylon as an abortifacient is a fast-growing evil. There is now in hospital a woman with wrist-drop from this cause, and Dr. Handford tells me that he has had in his wards three cases of lead encephalopathy and two or three others of less serious lead poisoning, all from taking diachylon. Two of these brain cases had to be transferred to the City Asylum. Inquiries I have made among medical men in one quarter of the town only—Sneinton—lead to the same conclusion. Thus Dr. Cole has sent two cases into hospital in the last year, and has seen several others. Dr. Dabell writes:

"'I remember two cases of poisoning due to diachylon taken to procure abortion. One was mild, with no nerve symptoms; the other was more severe, and her peripheral nerves were affected. Both recovered. I am now visiting a patient in a fairly good position who, in addition to a large quantity of purgatives, took a pennyworth of diachylon in one day, but with no effect. It is not uncommon for women to ask me about this drug.'

"Possibly the purgatives taken by this lady saved her from the ill-effects of the lead. Dr. William Thomson says:

"'I have had a good many cases of abortion due to lead poisoning from pills taken. Abortion usually occurs before nerve symptoms set in, although I had one case with severe anæmia, jaundice, albuminuria, colic, and slight wrist-drop. I think the practice is very common and on the increase, as I can recall half a dozen cases within the last year or two.'

"Dr. Cornwall writes:

"'I have had several cases such as you mention, and found the brain always more or less affected, also the peripheral nerves. Jaundice was common.'

"Thinking it would be of interest to ascertain whether persistent weakness of the brain often ensued, I wrote to Dr. Powell, of the City Asylum, who replied:

"'I have had two cases of insanity from the cause you name during the past year, both with melancholia, one having also active hallucinations of hearing. One recovered in three months, the other is now slowly recovering after a residence of five months, but there is much secondary mental enfeeblement.'

"These two cases were the two of Dr. Handford's already mentioned.

"Dr. Moore Bennett, of Ruddington, lately told me the practice was common in his rural district, and kindly sent me brief notes of three cases in which the abortion was associated with lead colic due to diachylon. In one of these there was also wrist-drop and much tremor, in another coffee-coloured vomit, and in the other septic metritis. All recovered after severe illnesses. Dr. Bennett thinks that these cases usually suffer from septic mischief.

"Dr. Cole also informs me that he has no doubt many women take the drug without ever coming under medical treatment for it, as he has been frequently told by patients that they have used it without the desired effect. He considered it a by no means certain abortifacient.

"Turning to the medical journals of the last few years, I find several cases of poisoning by diachylon taken to procure abortion. Dr. Pope, (Leicester) records two cases which died with cerebral symptoms. The late Dr. Crooke (Birmingham) described a similar fatal case, and expressed his belief in the common use of this drug. Dr. Bell Taylor gives a case in which the drug had no other effect than to produce optic atrophy and permanent blindness in the left eye.

Dr. Branson relates the case of a multipara who took a pennyworth of diachylon in forty-eight hours when three months pregnant. When seen a month later the uterus was empty, and she was suffering from severe colic. He adds that the Birmingham chemists told him diachylon is much used for this purpose.

"There can be no doubt that diachylon is largely used by women of various classes to procure abortion. It is easily purchased. Anyone can go to a chemist's and buy a pennyworth of diachylon, as I have myself done, without being asked any question except as to whether the purchaser wants it spread or in the mass. Penny balls of the emplastrum plumbi are kept by the most respectable chemists ready wrapped in a handy drawer, and there is absolutely no restriction on its sale. For a penny a woman can buy enough lead not only to empty the uterus, but to cause grave disease of the bowels, the kidneys, and the brain, a disease which not rarely proves fatal. The drug appears to be an uncertain abortifacient, always endangers and often destroys life, or leaves permanent bodily and mental enfeeblement. It is a question whether something should not be done to restrict the indiscriminate sale of this drug and to class it with poisons. Of course, lead can be bought in other forms—as in paint or putty, but we might at least limit the evil, and reduce temptation by removing the present dangerous facility for manslaughter or suicide."

Dr. Bostock Hill has kindly given the editor the following case:—

At the Staffordshire Summer Assizes in 1903 the case *R.* v. *Goodall* was heard, in which the prisoner was charged with manslaughter, and with supplying pills for the purpose of procuring abortion. The case was one in which pills of two kinds, namely diachylon and aloes respectively, were administered. As a result, the woman miscarried, and although she lived for a fortnight after taking the pills, finally died, with symptoms of intense headache, convulsions, anæmia, etc.

On analysis, lead was found in as small a portion as an ounce of the liver. It would appear that a quantity equivalent to 20 grains per day of the diachylon had been taken for several days. The prisoner was sentenced to seven years' penal servitude.

In a case which occurred in France *iodide of potassium* was pronounced by three medical men to be an abortive (*Med. Times and Gaz.*, 1859, 1, p. 116), but the reasons for this opinion are not given.

Phosphorus.—Popular opinion, in Vienna at any rate, ascribes to this extremely virulent poison an abortifacient power, and in that city fatal cases are very common. My colleague, Dr. Russell Andrews, when studying there for only a few months, saw at least two such. He was unable to supply me with any details, but such are needless, as the action of phosphorus as a poison is well known.

Combined Drugs and Local Violence.

A method much resorted to is to rupture the membranes by the insertion of a piece of whalebone or wire into the mouth of the womb till blood appears. Pills of oil of savin, sulphate of iron, and aloes, are then freely given to aid in the expulsion of the ovum.

THE NATURE OF THE EVIDENCE WHICH MAY BE GIVEN WHEN ANY OF THE FOREGOING METHODS ARE ALLEGED TO HAVE BEEN APPLIED.

Elsewhere will be found the signs of delivery—they need not be here repeated (*vide* pp. 64 *et seq.*). They simply prove (or disprove) the fact of delivery: we must discuss here the medical evidence of how or why delivered.

Evidence when Disease is Alleged as the Cause.—This cannot be discussed at full length; we have given a few of the more important or commonest diseases with which abortion is associated, and the medical evidence consists largely in showing (1) that such disease existed and (2) that there is no evidence, local or general, of violence or drugs having been employed. For the former the medical witness must use his own judgment and professional knowledge when acute or marked disease is in question, but he will have to trust to general information as to previous abortions or vaginal discharges, etc., for much that is valuable; local examinations may show old para- or perimetritis quite sufficient to account for abortion. Evidence as to drugs may be derived from the symptoms or from analysis—it will be of precisely the same nature as in poisoning. (*Vide* Sect. XVI., what to do in suspected poisoning; of local evidence of violence *vide* below.)

Evidence when Violence is Alleged.—When general violence has been criminally used, it is only the fact that marks of violence are found on a woman who is or was pregnant that can cause suspicion of attempted or completed abortion. The violence can be judged on general principles—the intention with which it was inflicted must be judged by circumstances. There is one point to be emphasised here: if a criminal has resorted to kneeling on the abdomen, much violence may be done internally without leaving any bruises on the skin (*vide* Vol. I., pp. 417, etc.).

When local violence is alleged, the question of criminality or rather of proving that such violence has been applied is very difficult, for, as we have seen, skilled criminal violence may leave no traces whatever.

In these cases a medical opinion should not be based upon the statements either of the woman or of her friends, but upon some distinct and satisfactory medical proofs that mechanical violence has been done to the womb, its contents, or its appendages. Peritonitis, or inflammation of the lining-membrane of the abdomen, may arise from a variety of causes. If we assign it to a particular cause, and thus implicate another in a felonious charge, we should do this only upon *medical* facts obtained by an examination of the dead or living body; we should deal with such cases as if we knew nothing of their history. In 1863, it was supposed that the death of Susannah Barker had been caused by attempts made to produce criminal abortion.

It appeared that after three days' illness, the deceased was taken in labour and was delivered of a dead child, which was between the sixth and seventh month of uterine age, and that she died a few hours afterwards. On an inspection of her body, it was found that the cause of death was peritonitis. She had previously complained of great pain in her abdomen, and there was no doubt that peritonitis was developed before she was delivered; in fact, the peritonitis appeared to be the direct cause of the abortion. She admitted to her medical attendants that she had taken some powders to cause miscarriage, and further, that a person calling himself a medical man had about a week before introduced two instruments into her body, which had caused her great pain. Besides extreme inflammation of the peritoneum, which was the immediate cause of death, the heart, lungs, and stomach were healthy, and the womb presented no appearances excepting those arising from recent delivery; it was perfectly natural, and free from all marks of injury. There was no injury to the vagina, nor any wound in the peritoneum itself. There was no mark of violence on the body of the child; in short, this could have sustained no injury, as the membranes surrounding it were not ruptured.

The medical man who examined this case thought that the fatal peritonitis had been caused by the introduction of instruments into the vagina, and that this might occur without leaving after death any traces of their employment. At the same time it was admitted that a speculum used in the ordinary way would not produce peritonitis, and it was alleged in defence that a speculum only had been used. The connection of the peritonitis with the alleged manipulations of the unlicensed practitioner rested more on surmise than proof. The absence of any bruise, puncture, or laceration affecting the vagina, uterus, or fœtus, with the fact that, whatever may have been the instruments used, the membranes were left entire, rendered it impossible to assign the peritonitis with certainty to the acts of the person who was charged with causing the death of the woman. For anything that appeared to the contrary, he might have used a speculum, and it is well known that this instrument, although frequently introduced into the vagina, does not cause peritonitis, [unless the speculum be septic and cause vaginitis, which may spread upwards.—Ed.]. The connection of the peritonitis with instrumental violence, therefore, was not established in this case, and the jury discharged the suspected person. They could not do otherwise, for there was not the slightest *medical* proof that any improper instrument had been introduced into the vagina with felonious intention.

A case occurred in which a druggist was charged with using instruments to cause abortion, leading to the death of a woman from peritonitis. It appeared also that he had given to her doses of the tincture of perchloride of iron. The woman was delivered of a dead fœtus at about the fifth month, and she herself died shortly afterwards. There was nothing in the body of the woman or of the fœtus to show that instruments had been used, but it was quite clear that peritonitis was the cause of death. One medical witness thought that an operation had been performed on the body of the woman, but it was admitted that peritonitis might arise from a variety of causes in a woman who had had a miscarriage (*Pharm. Jour.*, 1871, p. 256).

If wounds are found of only slight character, such as tears in the cervix, it may be impossible to say that they were not due to the child's head, but if on the outer or vaginal surface of the womb wounds are found, and especially *punctured* wounds of the vagina itself, these could not have been done by the child, and there is clear evidence of violence for a purpose.

In December, 1904, the editor met with a case in which there were two perforations of the cervix itself leading into Douglas' pouch, and causing death by peritonitis. They were obviously criminal, or at least caused by mechanical violence (Lond. Hosp. Post-mortem Records, December, 1904).

There is very clear evidence that when labour is impeded by a serious disproportion between the size of the head and the calibre of the passages the uterus may be torn (either in its body or in its attachment to the vagina) by its own contractions (*Lancet*, 1, 1902, p. 523; *B. M. J.*, 1, 1901, p. 19). If such be alleged to be the cause of such a rupture in a given case, there is usually abundant evidence to the contrary, for the abortionist using such violence rarely stops at vagina or uterus, but damages other organs as well. The clinical fact of such ruptures has a more important bearing when ordinary malpraxis is alleged against a medical man (*vide* Vol. I., pp. 85 *et seq*).

Marks on the Child.—It is obvious that when an instrument is used, injury may possibly be inflicted upon the child. This is more likely to happen with an ignorant person than in skilled attempts, and more likely with sharp pointed instruments than with blunt catheters, etc. If these marks be found they will be very important evidence; they may not be sufficient to account for its death, but that is not the question. If it can be proved that they have not resulted from accidental causes during gestation, or sequently to delivery, their presence may furnish strong corroborative evidence of the actual means by which abortion was produced.

Evidence when Drugs are alleged to have been given.—Medical witnesses should be careful in giving evidence on these occasions in reference to the properties of drugs. They have to consider in all cases of alleged criminal abortion by drugs whether the substance is noxious, and must be prepared for a close cross-examination on the ecbolic properties of the alleged administered substance, as well as its general action as a poison on the woman or child.

Thus in the case of *R.* v. *Wallis*, the counsel for the prosecution stated that he should show by the opinions of good medical witnesses, whose evidence on this point was remarkably strong, that pennyroyal was a well-known herb and "one calculated and well known to be calculated to procure abortion." The first edition of this work was misquoted in order to support this incorrect view, whereas all that was there stated respecting pennyroyal was that it was one of those substances which had acquired "popular repute" for procuring abortion (Prin. and Prac. of Med. Jur.," p. 782). It was not described as an emmenagogue or ecbolic, nor as a substance having any abortive or noxious properties.

Noxious Thing.—The actual words in use in the statute are "a poison or other noxious thing."

In *R.* v. *Wallis* (Winchester Aut. Ass., 1871), Brett, J., in addressing the grand jury, called their attention to the words of the statute, which declares that where any person shall unlawfully administer a poison or some other noxious thing, or shall unlawfully use any instrument or other means whatsoever, with intent to procure miscarriage, he shall be guilty of felony. He said that, having regard to the words "other means whatsoever," though there might be some doubt as to the construction of the statute, he should direct that in one count of the indictment the word "noxious" should be omitted, and he should hold that if the person accused did administer some drug or something which he thought would procure miscarriage with that intent, although the thing itself would not procure that miscarriage, he would, nevertheless, be guilty of the offence, and they ought to find a true bill.

According to this decision, it would appear that it is not in all cases necessary to prove by medical evidence that the substance procured or administered was of a noxious nature. The words of sect. 59 as to procuring a noxious thing, or any instrument or "thing whatsoever," strictly interpreted, would include all substances, noxious and innoxious. If this view is generally adopted in future cases, medical evidence will be much simplified. Counsel will not be under the necessity of severely cross-examining medical witnesses on the strict meaning of the word "noxious." In *R.* v. *Wallis* (*supra*) the substances procured by the accused were not noxious, but the jury acquitted him on the ground that he did not administer the drugs; hence the question of noxiousness did not formally arise. From the ruling in this case it would appear that if a person procured or administered castor-oil or camphor julep with intent to procure miscarriage, and with the belief that the substance would produce it, he would be found guilty of the offence. This being so, the use of the words "poison" and "noxious thing" in the statute is surplusage, and tends only to cause confusion in the medical evidence.

It is probable, however, that this ruling will not be accepted in all cases; we may then reasonably consider the idea of noxious in our present subject.

In Sect. XVI. will be found a wider discussion and an attempt to define poison and noxious thing with reference to all circumstances. We may here confine ourselves to a brief discussion of the following questions:—

1. *For what alleged symptom was the drug in question administered? Why was the particular drug chosen?*

Women will frequently deceive a medical man with regard to their symptoms in order to induce him to administer drugs, which they hope may have the desired effect, but often enough an abortionist will wilfully mis-state symptoms in order to shield himself. Cross-examination should here be able to bring out the motives. A man was, for instance, accused of procuring abortion by administering oil of savin.

> The medicinal dose, as an emmenagogue, on the authority of Christison, is from two to five *minims*, and according to Pereira from two to six *drops*. The quantity given by the prisoner, although a full dose, was not, therefore, greater than these authorities recommend; and his criminality appears to have rested not so much on the dose given, as on the question whether he knew or, as a medical man, had reason to *suspect* that the female for whom he prescribed it was pregnant. No medical authority would recommend oil of savin in full doses for *pregnant* women; and with regard to the existence or non-existence of pregnancy in a special case, medical men are reasonably presumed to have better means of satisfying themselves than non-professional persons. The prisoner's innocence, therefore, rested on the presumption that he implicitly believed what the prosecutrix told him regarding her condition—that he had no reason to *suspect* her pregnancy, and therefore did not hesitate to select and prescribe a medicine which certainly has an evil reputation, and is rarely used by medical practitioners. According to the evidence of the prosecutrix, she informed the prisoner that she had disease of the heart and liver, and that nothing more was the matter with her. There can, it appeared to the author, be no doubt that the oil was administered with a guilty intention. Every qualified practitioner, acting *bonâ fide*, would undoubtedly satisfy himself that a young woman whose menses were obstructed was *not pregnant* before he prescribed

full doses of this oil three times a day, or he would fairly lay himself open to a suspicion of criminality. If pregnancy—a frequent cause of obstructed menstruation—were only *suspected*, this would be sufficient to deter a practitioner of common prudence from prescribing, in any dose, a drug which may exert a serious action on the uterine system (*Med. Times and Gaz.*, 1852, 1, p. 104).

2. *Is the alleged drug known or reputed to have any specific and direct action on the uterus?*

Attention must be drawn to the distinction between known and reputed—the former refers to decent medical works, the latter to hearsay amongst the ignorant laity. The *Lancet* (*l.c.*), with reference to those we have mentioned above, sums the position up as follows :—

"*Conclusions as to Emmenagogues.*—There can be no doubt that some drugs possess an emmenagogic action, but exact evidence as to this is wanting in the great majority of drugs with such a reputation. Amongst the most efficient are potassium permanganate, manganese dioxide, caulophyllin, pulsatilla, aloes, borax, senecio, and myrrh either alone or combined with iron. Abortion has followed the use of cantharides, caulophyllin, cimicifuga racemosa (?), potassium permanganate, senega, and pennyroyal (?). It is quite possible that any one of these drugs in large doses might cause abortion in a person predisposed to it, but there is no evidence to show that, except in excessive doses, they will cause abortion in a healthy woman. Of the indirect emmenagogues only the powerful purgatives are likely to produce abortion, and that through causing congestion of the pelvic organs and possibly from the causation of minute hæmorrhages in the mucous membrane of the uterus owing to the straining which they cause."

To these we must from evidence add at any rate lead and phosphorus, ergot, rue, and savin.

3. *Is it known to have produced abortion?*

This must be answered in the affirmative of all the drugs we have been considering, or, rather, perhaps it is more correct to say that abortion has been known to follow after their administration.

4. *In what doses and with what frequency was it administered?*

Savin, ergot, and rue are irritant; and they become noxious when given in large doses, or in small doses frequently repeated. Aloes and castor-oil are innocent when taken in small doses; but they acquire noxious or injurious properties when administered frequently, or in large quantity, to a pregnant woman. The small quantity of the substance taken at once does not affect the question, provided the dose be frequently repeated.

In one case (Exeter Wint. Ass., 1844), two powders, weighing each one drachm, were prescribed by the prisoner; one consisted of colocynth, the other of gamboge, and with them was half an ounce of a liquid (balsam of copaiba). They were to be mixed together, and a fourth part to be taken four mornings following.

Reynolds said, in answer to the question whether such a mixture was noxious or injurious, that each dose would be an active purgative, and might thereby tend to produce abortion. One dose would not be productive of mischief in a healthy country woman, but its frequent repetition might lead to serious consequences in a pregnant woman.

A few years ago the editor was called upon to give evidence under the following circumstances: A man had given a pregnant woman twenty drops of Tinct. Ferri Perchlor. three times a day. Of course such a drug in such doses was perfectly harmless, though other evidence threw great suspicion on the intent of the prisoner, who was, however, acquitted.

Hence when purgatives, or indeed any drug, is known to have been administered to a woman in excessive doses or with excessive frequency, one must ask the question why?

5. *Is the drug in question commonly recognised as an active poison?*

This obviously raises the further question, If so, why was it administered at all? Lead, savin, rue, phosphorus would naturally come under this head. In *R.* v. *Whisker* (Norwich Lent Ass., 1846), it was proved that the prisoner had caused to be taken by the prosecutrix a quantity of *white hellèbore*, in powder, for the purpose of procuring abortion. One medical witness said he considered hellebore to be noxious to the system, but he knew of no case in which it had produced death; and under these circumstances he did not consider himself justified in calling it a poison. Another medical witness stated, in his opinion, it belonged to the class of poisons. The judge, in summing up, told the jury that *that* was to be regarded as a poisonous drug which, in common parlance, was generally understood and taken to be such; and he thought the medical evidence sufficiently strong to bring hellebore within the meaning of the statute. The jury found the prisoner guilty, alleging that in their belief white hellebore was a poison. (*Med. Gaz.*, vol. 37, p. 830.) The only circumstance calling for remark in this case is, that any doubt should have been entertained by a medical practitioner respecting the poisonous properties of white hellebore. It is a powerful vegetable irritant, and has caused death in several instances; yet on this occasion it appears to have been admitted to be *noxious*, but not *poisonous*.

It must, however, never be forgotten, with reference to this crime, that whether the drug would or would not, whether it did or did not, have the intended effect, and whether the woman is injured or not—all these are quite immaterial if only the motive can be reasonably proved to the satisfaction of the jury.

For the following case in point the editor is indebted to D. Cotes-Preedy, who prosecuted:—

> "At Staffs. Ass., November, 1909, before Jelf, J., *R.* v. *Simpson*. Prisoner was convicted under sect. 59 of the Offences against the Person Act, 1861 (24 & 25 Vict. c. 100), for causing to be sent to a girl, whom he had seduced, a box containing 132 pills (Pilula Aloes et Ferri, B.P.) with directions to take between 20 and 30 a day. Sentence: six months' hard labour."
>
> I prosecuted in the case and submitted to jury that they could convict if they believed that the pills, though harmless in themselves, were sent with the intention that the girl should produce a miscarriage which the medical men said was possible. Jelf, J., directed the jury in the same way.

"To sum up, no single drug in ordinary doses can be said to be a certain abortifacient. Some drugs, such as cathartics, from their action upon neighbouring organs, may produce abortion. Other drugs, such as cantharides and savin, only produce abortion when given in poisonous doses and by producing poisonous symptoms. Others, such as ergot, undoubtedly act upon the uterus, and if taken in a number of cases will no doubt in a few set up uterine contractions and so induce abortion. The majority of so-called abortifacients are therefore uncertain in their action, and their exact *modus operandi* has yet to be worked out. It may be said, however, that any pregnant woman taking a reputed emmenagogic or ecbolic drug in large or even at times in normal doses runs a risk of producing abortion, especially if she has had previous miscarriages. It is nevertheless impossible to say that any given drug in any given dose will produce abortion with certainty, and therefore the **production of legitimate abortion by means of drugs is never practised at the present day** for this reason."

Far otherwise is it with **abortion-mongers,** who fatten on the credulity and folly of women.

In the series of articles which we have utilised so largely the *Lancet* gives many analyses of the pills and potions received from these creatures. To repeat most of them would be waste of space, but the following account of *R.* v. *Bedford* may serve as an example.

R. v. *Bedford.*—About the end of October, 1897, Superintendent Barry wrote a letter to the defendant representing himself to be "Mrs. E. A. Y.," a woman two months advanced in pregnancy, with the suggestion that the defendant should supply something to procure abortion, and on the 18th November he received in reply a cigar-box containing an 8-oz. bottle of medicine and a box of twenty-four pills and a letter instructing "E. A. Y." to take "two tablespoonfuls of the medicine night and morning," and that "the bottle will require a good shaking before taking it," and "you must take three pills with each dose of medicine."

The following table shows the result of Mr. Orsman's analysis of the medicine and pills :—

	Total quantity found in 8-oz. bottle by Mr. Orsman.	Quantity in each dose of medicine.	Quantity found in each pill.	Quantity in each dose of pills.	Total at one time for 4 days, night and morning.
Colocynth .	67 grs.	8½ grs.			8½ grains
Aloes. .	90 grs.	11grs.	Extractive matter containing both aloes and ergot, 1·7 grains	Extractive matter probably about 5·1 grains 2·5 grs.	13·5 grs. about
Ergot (really Ergotin)				2·5 grs.	2·5 grs. about
Borax .	77 grs.	9½ grs.	...	...	9½ grains
Savin .	5 grs.	$\frac{6}{10}$ of a grain	·21 grain	·63 grain, about	1·23 grs., about
Sulphate of Iron .	...	...	·96 grain	3 grains, about	3 grs., about
Hellebore .	...	...	1·2 grains	3 grains, about	3 grs., about

On Friday, the 19th day of November, Superintendent Barry sent a woman named Alice Brear to defendant's. Alice Brear represented herself to have missed her courses for about nine weeks, and said she did not want to be bothered with any more children. The defendant supplied her with an 8-oz. bottle of medicine and a box of pills, and also a powder. The result of Mr. Orsman's analysis of these three things, and of the instructions given by the defendant, would be as follows :—

	Total quantity found in 8-oz. bottle by Mr. Orsman.	Quantity in each dose of medicine.	Quantity found in each pill.	Quantity in each dose of pills.	Total at one time.
Aloes	90 grs.	11 grs.	Extractive matter containing both aloes and ergot, 1·7 grains	Extracted matter, 3·4 grs., probably containing 1·7 grs.	12·7 grs.
Ergot (really Ergotin)				1·7 grs.	1·7 grs.
Borax	77 grs.	9·5 grs.	...	...	9·5 grs.
Oil of Savin	5 grs.	·6 gr.	·21 grain	·41 grain	1·1 grs.
Sulphate of Iron	...	...	·96 grain	2 grains	2 grs.
Hellebore (?)	...	...	1·2 grains	2·4 grains	2·4 grs.

That is, on Friday night, the 19th, she would take the quantities mentioned in the last column; on Saturday morning, the 20th, she would take similar quantities; on Sunday, the 21st, she would take similar quantities three times during the day; on Monday morning she would take similar quantities three times during the day; and she would then take the powder at two equal doses. The powder consisted of 58 grains of colocynth.

On the 1st December Superintendent Barry sent a woman named Alice Hockin to the defendant's. Hockin informed the defendant that she had missed her courses for seven weeks. The defendant gave her a bottle of medicine and a box of pills, and instructed her to take two pills and two tablespoonfuls of the medicine at the same time twice a day. The result of Mr. Orsman's analysis will be seen in the following table:—

	Total quantity found in 8-oz. bottle by Mr. Orsman.	Quantity in each dose of medicine.	Quantity found in each pill.	Quantity in each dose of pills.	Total at one time for 4 days, night and morning.
Colocynth.	67 grs.	8½ grs.	...	...	8½ grs.
Aloes	90 grs.	11 grs.	Extractive matter containing both aloes and ergot, 1·7 grains	Extractive matter, 3·4, probably containing 1·7 grs. about	12·7 grs., about
Ergot (really Ergotin)				1·7 grs. about	1·7 grs., about
Borax	77 grs.	9·5 grs.	...	...	9·5 grs.
Oil of Savin	5 grs.	·6 gr.	·21 grain	·41 grain	1·1 gr.
Sulphate of Iron	...	...	·96 grain	2 grains	2 grs.
Hellebore (?)	...	...	1·2 grains	2·4 grains	2·4 grs.

Superintendent Barry subsequently ascertained that the pills were supplied by a Liverpool firm (Sumner & Co., of Lord Street, wholesale chemists), and they informed him that Mr. Orsman's analysis was practically correct, and the pills were what were known in the trade as an emmenagogue.

The analyst was Mr. William James Orsman, the Wigan county borough public analyst.

The defendant advertised herself as Madame Bedford, female specialist and medical herbalist. The jury found her guilty of supplying noxious things, etc., with intent, etc., and she was sentenced to six months' imprisonment with hard labour on 6th January, 1898.

The following, taken from the *Lancet* (1, 1899, p. 588), is a dreadful commentary on the ways of these gentry, and shows incidentally the difficulty of deciding as to whether abortion had been criminally induced or not:—

> At the Hackney Coroner's Court on Monday last Dr. Wynn Westcott held an inquiry respecting the death of an unfortunate woman who died from hæmorrhage consequent on abortion. Evidence was given that the deceased had attempted to obtain medicine for certain purposes from Madame Frain. The jury returned a verdict to the effect that "the deceased's death was due to syncope, the result of hæmorrhage, consequent on abortion, for which no cause has been proved, and the jurors, having heard the evidence as to the manner and conduct of the business called that of 'Madame Frain,' are of opinion that the business is either fraudulent or felonious." The coroner said that "Madame Frain's" business had at one time a most evil reputation, and the *Lancet* had designated the advertisements issued by the firm as "disgusting." No steps had been taken by the proprietors to disprove the insinuation, so he concluded that they did not wish the truth or otherwise of the *Lancet's* statement investigated.

FEIGNED ABORTION.

For various motives, into the consideration of which it is unnecessary to enter, a woman may charge another person with having attempted or perpetrated the crime of abortion. Such a charge is not common, because, if untrue, its falsity may be easily demonstrated. A young woman, admitted into Guy's Hospital in 1846, charged a policeman (who, according to her statement, had had forcible intercourse with her) with having given her some substance to produce abortion and having subsequently effected this mechanically. She was not examined until nearly two months after the alleged perpetration of the crime, when Lever found that there was no reason to believe that she had ever been pregnant. This was a case of feigned abortion. When charges of this serious kind are brought forward they are always open to the greatest suspicion unless made immediately after the alleged attempt, as it is then only that an examination can determine whether they are true or false. If so long delayed as in this instance without any satisfactory reason, the assumption is that they are false.

ABORTION OF MONSTERS, MOLES, AND IN EXTRA-UTERINE FŒTATION.

The law uses the term miscarriage, a popular word, and it intends thereby to mean the contents of a gravid uterus, whether such contents be well or ill formed, living or dead, moles, or any other result of conception; the thing is the *intent* with which an operation was done or a drug given.

Again, a person would be equally amenable for the attempt whether the fœtus was in the uterus or in the Fallopian tube. For a case of attempting to procure abortion in extra-uterine fœtation see "Obst. Trans.," vol. 5, p. 154. The symptoms of extra-uterine pregnancy, especially of the tubal kind, are similar to those of ordinary pregnancy, and are not to be distinguished from them in the early stages (*Med. Gaz.*, vol. 36, p. 103). In an advanced stage the case is different; the symptoms are wholly unlike those of pregnancy, and may wrongly give rise to the suspicion that the woman has died from criminal interference.

A young lady, supposed to be some months advanced in pregnancy, died very suddenly soon after taking some medicine prescribed for her by a physician. She had enjoyed excellent health, with the exception of being occasionally subject to slight abdominal pains threatening abortion, and to relieve these pains a physician was consulted. It seems that she had aborted on a previous occasion. She was found to be in a state of great depression, but not suffering at the time from any dangerous symptoms. The physician had prescribed a sedative medicine, of which the patient had taken only three doses when she fell into a deep sleep, and in this state she died, the symptoms of depression not having been relieved. The family attributed her death to some mistake in the preparation of the medicine. The tribunal before which the charge of poisoning was laid directed an inspection of the body. The result was that a quantity of blood was found effused in the lower part of the abdomen. This had obviously arisen from the rupture of a tumour, containing an embryo of which the remains were found in the midst of the clots of blood in the pelvis. It appeared to be of only a few weeks' development. The body had been contained in a cyst external to the uterus, which had suddenly given way, and had thus led to fatal hæmorrhage.

It was the suddenness of death soon after taking medicine, without any preceding symptoms of illness or any other obvious cause except the medicine to account for her condition, that gave rise to the inquiry. An excellent illustration of what a post-mortem may do.

SUB-SECTION I.—NATURAL BIRTH AND MEDICO-LEGAL QUESTIONS CONNECTED THEREWITH.

1. THE LEGAL POSITION OF THE UNBORN CHILD "EN VENTRE SA MÈRE."
2. BIRTH INDEPENDENT OF WHETHER ALIVE OR DEAD.
    - DEFINITION OF BIRTH.
    - SEX OF CHILD.
    - ITS EXACT TIME.
    - CÆSAREAN SECTION.
    - CRANIOTOMY.
3. INHERITANCE; TENANCY BY COURTESY.
    - MONSTERS.
    - PLURAL BIRTHS.
4. LIVE BIRTH.
    - EVIDENCE FROM MUSCULAR MOVEMENTS.
        - ,, ,, WARMTH AND RIGOR MORTIS.
        - ,, ,, CRYING.
        - ,, ,, RESPIRATION: HAS THIS CHILD BREATHED?
            - CHANGES IN SHAPE OF CHEST.
                - ,, ,, POSITION OF DIAPHRAGM.
                - ,, ,, THE LUNGS.
                - ,, ,, STOMACH AND BOWELS.
        - ,, ,, CIRCULATION.
        - ,, ,, CONTENTS OF ALIMENTARY CANAL.
        - ,, ,, THE MODE OF BIRTH.
        - ,, ,, THE UMBILICAL CORD.
        - ,, ,, THE SKIN.

THE UNBORN CHILD.

So long as an infant remains in the womb it is said in law to be *en ventre sa mère;* but it is legally supposed to be born for many purposes (Blackstone's Comm.). A child in the womb may have a legacy or an estate made over to it; it may have a guardian assigned to it; but none of these conditions can take effect unless the child is born alive. So the fœtus may be made an executor; but it is very judiciously provided that an infant cannot act as such until it has attained the age of seventeen years. The Roman and English systems of law apply the same term (*venter*) to the unborn child; when born dead it is called *abortus*, abortion; when alive, *partus infans*, infant. In 1871, the following case affecting the *venter* came before the Court of Admiralty.

A ship was damaged, in collision with another, called the *Eleutheria*, and a man named Noyes, one of the crew of the damaged ship, was killed. The widow claimed of the proprietors of the *Eleutheria*, damages in respect of a child with which she was then pregnant. Sir R. Phillimore held that the child was entitled to recover for the loss sustained of its father, although the damages could not be assessed until the child was born.

The maxim of English law derived from the Roman law is that a child *en ventre sa mère* is to be considered as actually born if any question arises for its benefit. The ruling was confirmed by Lord Westbury in *Blasson* v. *Blasson*, but this fiction is applicable only for enabling such child to take a benefit to which it would have been entitled if actually born. In the case decided by Phillimore the action of the court was suspended until the child was born, as if still-born there would be an end to any claim (*Med. Times and Gaz.*, 1871, 2, p. 146).

It is questions of this sort that call legally for the determination of the existence of pregnancy in any woman claiming damages. A similar idea of the possibility of children being born is at the bottom of the fact that wills made before marriage are invalidated by a subsequent marriage unless certain formalities are gone through.

The medical interest only lies in the establishment of pregnancy (Sub-section C) and subsequently in the nature (sex, shape, etc.) of the products of conceptions (*vide infra*).

In June, 1904, a curious decision was left to the judge of the Blackburn County Court, viz., to apportion the sum of money awarded to the family of an employé who had been killed on the railway. The recipients were a widow and two children. But a third child was expected, and the question at issue was as to whether the posthumous offspring would be entitled to share in the amount. In the absence of any specific provision for meeting such a situation, the learned Judge wisely resolved to postpone the apportionment and to give the widow leave to apply again. In due course, it might be found that there were four or even five children to be provided for.

BIRTH ALIVE OR DEAD.

The law of England has not defined the meaning of the term "birth" in reference to either criminal or civil jurisprudence, but if we are to be guided by the numerous decisions which have been made on trials for infanticide, it must be regarded as signifying "the entire delivery of a child," with or without its separation from the body of the mother. (See "Infanticide"; also Chitty, "Med. Jurispr.," 412.)

Some have considered that *partial birth*, provided a child is living, should suffice to confer the same rights on the offspring as the proof of entire birth. The following case has been adduced by Locock in support of this view, although the question here was rather in reference to the actual date of birth than to the acquisition of civil rights therefrom: the principle is, however, the same.

On a Saturday evening a lady was taken in labour with her first child. The head and one arm were born two or three minutes before a neighbouring clock struck twelve. There was a cessation of pain for several minutes, during which time the child cried and breathed freely. The rest of the body was not expelled until full five minutes after the same clock had struck twelve. Was the child born on the Saturday or the Sunday?

Certainly the birth was not completed until the Sunday: the child was still partly within the body of the mother—the circulation was still kept up through the umbilical vessels: "but," continues Locock, "I gave my opinion that the child was born on the Saturday. I considered that the child had then commenced an independent existence. The fœtal life had then to all intents and purposes ceased ; and breathing—a function incompatible with the condition of a fœtus—had commenced. The navel-string will, it is true, go on pulsating for many minutes after an infant has been brought completely into the world, crying and kicking, unless it be compressed artificially ; and yet no one will say that a child in such a case is not born until we choose to take the trouble to tie the navel-string. The child would not have been damaged if it had remained for hours or even days with merely its head and arms extruded ; it could have been fed in this situation" (*Med. Gaz.*, vol. 12, p. 636). However reasonable, *medically* speaking, this view may appear, a medical jurist must shape his evidence according to what the law demands. It is elsewhere stated ("Infanticide," *post*) that our judges have distinctly laid down the law that no child can be considered to be *legally* born until the *whole* of its body has come *entirely* into the world. This is in relation to criminal jurisprudence, in which case, if in any, the rule should be relaxed, because its relaxation would tend to punish the wilful destruction of living infants partially born. This child could not, therefore, have been born on the Saturday, because the law does not regard partial birth as entire birth ; and respiration and birth are not synonymous terms. Supposing this child to have died before its body was entirely extruded, it could not be said, even medically, that it was born alive ; and certainly it could not be considered, according to the present state of the law, to have acquired the rights of a child born living. The reasonableness of the opinion that partial birth should suffice for all the legal purposes of entire birth is a distinct question, and one over which a medical witness has no sort of control. Whatever apparent injustice may be done by adhering to this rule in respect to the civil rights of persons, there is no doubt that the evil is really of great magnitude in relation to criminal jurisprudence ; for it would appear that the destruction of partially born children, although alive and healthy, is not, legally speaking, murder.

On the other hand, some difficulty might arise in civil cases if the bare extrusion of a *part* of the body sufficed for all the legal purposes of *entire* birth. It might become a casuistical question as to how much of a child's body should be in the world in order to constitute legal birth ; for there is no reason why, in a medical view, the extrusion of the head and shoulders should constitute birth any more than the extrusion of a hand or a foot. If it be said that the act of breathing should be combined with a partial extrusion of the body, this would be unjust ; because the child is alive—its heart is evidently pulsating, and its blood circulating, as freely before the act of breathing as afterwards. Besides, it is admitted that children may be born alive, and live for some time, without breathing (*vide* "Infanticide") ; and this want of respiration is no objection to these children being considered living in law. In cases referred to hereafter, children were legally pronounced to have been born alive, although they had certainly not breathed ; and that a child may manifest life for a certain time without leaving in the lungs any evidence of breathing is clear from numerous reported instances (see "Atelectasis" "Infanticide"). If, then, proof of breathing is not demanded in cases of entire, it could scarcely be required in cases of partial birth.

It is now a definitely accepted principle in all legal proceedings that birth must be defined as the "**complete extrusion of the products of conception outside the maternal genital passage, so that no part of them lies even within the vulval outlet.**"

Of birth in general apart from the question of whether the child be alive or dead there are one or two points to be considered:

(*a*) The sex of the child.
(*b*) The actual time.
(*c*) Cæsarean section.

(*a*) The **sex** of a child must be noted carefully (*vide* Vol. I., pp. 174 *et seq.*, for a full discussion of sex). The Registrar-General's clerk states that pseud-hermaphrodites are classed as males; should they turn out later to be females, they must make a statutory declaration to that effect; of such cases about three occur yearly. There are no special rules for dealing with double monsters (S. B. Atkinson, *Lancet*, 2, 1904).

(*b*) **Date of Birth.**—Medical evidence has occasionally been demanded in courts of law respecting the actual date of birth of individuals, in cases in which a period of a few days, hours, or even minutes was required to prove the attainment of majority, meaning thereby a legal responsibility for the performance of civil contracts into which the parties have entered, either knowingly or ignorantly, when minors. Some cases of this kind have been decided by the evidence of the accoucheur himself; others, when the accoucheur was dead, by the production of his case-books; and the strictness and punctuality of some medical practitioners, in making written memoranda of cases attended by them, have in more than one instance led to a satisfactory settlement of such suits; this point has been already noticed under "Age" (*vide* Vol. I., pp. 204 *et seq.*). The proof of the exact date of birth is also of considerable importance in certain cases of contested legitimacy. Here it is not so much a question of hours and minutes as of days and weeks. The matter has been fully considered under the head of "Legitimacy" (*q.v.*).

(*c*) **Is Cæsarean Section Birth?**—Among the Romans it was decreed by Muna that no pregnant woman should be buried until the fœtus had been removed by Cæsarean section: and the Italian laws also made this operation necessary. In 1491 the first authentic case is recorded of the operation being performed on a living woman. The Cæsarean operation has until recently rarely been performed in England, except when a woman was actually dying or dead. Goodman performed this operation successfully on a woman in November, 1845. This child was extracted alive, and the woman perfectly recovered from the operation (*Med. Gaz.*, vol. 36, p. 1392). Of late years, with the modern improvements in surgery, the operation has become too common to need illustration, and in the hands of a careful and skilful operator is considered one of the safest of abdominal operations of any magnitude and severity. Cases of its second and even third performance are not rare (*B. M. J.*, 1902). The husband or representative of the parturient woman may object to the performance of this operation, even although the child may be living in the womb, and there may be a reasonable hope, by an immediate operation, of extracting it alive. Lever met on two occasions with husbands who refused to allow him to operate on the dead body of the wife. No medical man would proceed to operate by force, or against the will of the husband; at the same time, in refusing his permission, the husband is not guilty of any legal offence.

Important legal consequences may hereafter ensue from a more general adoption of this practice in England in respect to deformed women. Thus, supposing in any case a child were removed alive while the mother was living, both of them dying shortly afterwards—would the husband become a tenant by courtesy? The law says that the child must be *born;* and some lawyers would find ground for arguing whether extraction by the Cæsarean operation should be regarded as "legal birth." According to Fonblanque, the question is settled in the affirmative—a child extracted is a child born (*Med. Jur.*, vol. 1, p. 236). Our ancient law authorities do not appear to have contemplated that such an operation would ever be undertaken on a living woman. The words of Lord Coke, which are considered to express the state of the English law, are, "If a woman seised of lands in fee taketh husband, and by him is bigge with child, and in her travell dyeth, and the child is ripped out of her body alive, yet shall he not be tenant by the curtesie, because the child was not born during the marriage, *nor in the life of the wife*, but in the meantime her land descended." According to other authorities, the Cæsarean operation does not divert the course of descent, or divest the husband of the life estate, provided the child be born alive, and the mother was living when the child was born ("Obst. Rec.," vol. 3, p. 66). *Birth*, and extraction by the Cæsarean operation, are, therefore, treated as similar conditions.

The editor is unable to find any recent legal decision on the point, but apparently the principles of the law are simple enough; the only observations that require to be accurately made are (1) the precise moment when the child was extracted, (2) the question of whether it showed signs of life after extraction ("Live Birth," *q.v.*, *post*), and (3) the precise moment when the mother died if she did so die. It is possible that cases may arise in which the mother may die under the anæsthetic, and the last point may be difficult to determine and even give rise to diffierences of opinion between the surgeon and the anæsthetist, but no rules can be laid down for such cases—each one must be determined on its own merits by the facts actually observed (*vide* "Signs of Death," Vol. I.).

As regards the justifiability of the operation for the extraction of a child that cannot by any other means be delivered *alive* there can be no question, but when the woman and the husband decline, it is obviously not justifiable, though the obstetrician must naturally place before them the risks of the alternative methods of emptying the uterus. If one of the two desires it and the other objects, a very delicate position may arise upon which the editor can only offer this piece of advice: the woman is the medical man's patient and therefore the person whom he is bound to assist to the best of his ability, and whose wishes should therefore, within reason, be first acceded to; it will be noted that *within reason* almost begs the whole question, but the editor does not think it wise to lay down the law more strictly. For a case of Cæsarean section by a midwife and comments thereon *vide Lancet*, 1, 1901, p. 1841.

If it have been determined that the operation shall be done, it is quite obvious that the later, up to full time, it is done the better the chance of the child surviving, and unless some special circumstances on the part of the health of the mother demand its earlier performance it would seem natural that it should be done as near the 280th day as possible.

It is very uncertain how long a child *in utero* may live after the death of the mother—it has been stated that it may so survive some hours, but this is not borne out by common experience, and all are agreed that no time should be lost if a living child be desired. Dr. Herman informs the editor that the longest survival he can find reported is twenty-three minutes, but five or ten minutes is more usual. It is probable that in most cases the child dies as soon as the mother. For further reference the reader may consult "Obstetrics," by J. W. Williams, or Eden's "Pract. of Midw.," 1908.

To the original writers on Common Law (Coke, Blackstone, etc.) Cæsarean section meant only post-mortem (of the mother) extraction.

It has not infrequently happened that in ordinary parturition a child is born alive (and survives to adult life) after the death of the mother. At least one such case is well known to the editor.

For a case of Cæsarean section in which the evidence of eye-witnesses differed from that of experts who only saw the dead body *vide* the 4th edition of this work, Vol. II., p. 223.

Craniotomy.—This means that it is necessary to destroy the child to effect delivery, which otherwise could not take place without leading (probably) to the death of the woman. This operation would not give rise to any medico-legal questions, except in a case in which the child had not been completely destroyed before entire delivery. Craniotomy, as the name implies, consists in cutting through the cranium and destroying or removing the brain of the child. If with the brain the upper part of the spinal marrow is also destroyed, the child comes into the world dead. Under other circumstances there may be movements of the limbs or body after delivery (see case, Guy's Hosp. Rep., 1866, p. 477). The existence of these movements, properly attested by the accoucheur, might furnish important evidence in cases of tenancy by courtesy, contested inheritance, or succession to property. It would be for the court to decide, under the proved medical facts, whether the child had manifested any signs of life, in a legal sense, after its entire delivery from the body of the mother, and while she was yet alive.

In the year 1889, the following case occurred to the editor. He was sent for to a case of obstructed labour, due as he found to hydrocephalus of the child; he perforated the presenting head, and the child was almost immediately born with a great rush of water; the child was undoubtedly *completely born alive*, but it did not survive many minutes; it cried, it moved, and its umbilical cord showed pulsations.

Had this been the case of a child born to an inheritance, there is no doubt that the editor could have sworn to live birth, although it had received a mortal wound.

If something more violent than puncture be performed on the child's head (**craniectomy, cephalotripsy,** etc.) there can arise no question of live birth.

INHERITANCE.

Apart from the fact that a testator, provided he be of age, and of sound mind, can leave legacies to whom he will, whether legitimate or otherwise, there are certain points in the laws of inheritance with which a medical jurist must be acquainted, for not infrequently his assistance is required by the law to determine how legacies shall pass.

Leaving then any question of specific testamentary disposition of property, the ordinary principles of inheritance are connected with :

1. The exact times of birth and death.
2. The legitimacy of the child (*vide* "Legitimacy," pp. 85 *et seq.*).
3. Tenancy by courtesy.

On the importance of noting the **exact hour of birth and death,** we have already sufficiently insisted for many purposes. In our present connection, a case such as this might arise—while the woman is actually in labour, the husband, or father rather, might be killed or die, the mother might die during parturition, and the child might die, and it might then become, according to the terms of the will, or according to the law of intestacy, a very important question to decide the precise moment of the birth of the child, or of the death of father or mother. The editor is not acquainted with any such case, but it is easily conceivable that such a case might arise, and would have to be decided by medical evidence, the mere law on the subject being of course perfectly clear.

A child that is born alive, or has come *entirely* into the world in a *living* state, may by the English law inherit and transmit property to its heirs, even although its death has immediately, and perhaps from morbid causes necessarily, followed its birth. Should the child be born dead, whether it died in the womb or during the act of birth, it does not acquire any civil rights; for it is not regarded legally as a life in being, unless it manifests some signs of life *after* it is entirely born and separated from the mother. The Duke of Wellington's birth appears to have been wrongly stated as April 30th, when it was really May 1st.

Tenancy by Courtesy.—This signifies, according to Blackstone ("Comment."), a tenant by the courts of England. If a married woman possessed of estate die, the estate passes from the husband to her heir-at-law, unless there has been a child born *living* of the marriage, in which case the husband acquires a life interest in the property. This singular custom is of great antiquity. Incurable sterility, a protracted labour, deformity in the pelvis of the wife, or the necessary performance of craniotomy on a healthy well-formed child, may, under this custom, lead to an aversion of the inheritance. The tenancy, in contested cases, is generally established or disproved by medical evidence ; and the following are the conditions which the law requires in order that the right should exist :—

1. The child shall be born alive. The subject of live birth will be found fully discussed below.

2. The child shall be born during the life of the mother. This point itself is easy enough to determine ; for cases in which there might be some little difficulty *vide* "Cæsarean Section," and "Craniotomy," above.

3. The child must be born capable of inheriting. This is a question of monstrosity (*vide* below).

Cases of tenancy by courtesy are not common; the following are from previous editions of this work:—

Fish v. *Palmer*, which is reported to have been tried in the Court of Exchequer in 1806 (Beck's "Med. Jur.," vol. i., p. 354). The wife of the plaintiff Fish was possessed of landed estate in her own right. She died in 1796, after having given birth to a child which was supposed at the time to have been born dead. In consequence of the plaintiff not having had a living child (as it was assumed) during the marriage, the estate of the wife was claimed and taken by the defendant Palmer, her heir-at-law—the husband being obliged to surrender it under the circumstances. From information derived many years after the death of his wife from some women who were present at the delivery, the plaintiff was led to believe that the child had not been born dead, and that the estate had therefore been surrendered to the defendant under a mistake. An action was brought to decide this question in 1806, ten years after the death of the wife, and it lay with the plaintiff to prove his allegation that the child had been born *living*. The accoucheur had died some time before the trial; but it was proved that he had declared the child to have been living an hour before it was born, that he had directed a warm bath to be prepared, and when the child was born, gave it to the nurse to place it in the bath. The child never cried nor moved after its birth, nor did it manifest any sign of active existence; but the two women who placed the child in the bath swore that when it was immersed there appeared twice a *twitching* or *tremulous motion of the lips*. They informed the accoucheur of this, and he directed them to blow into its throat, but it did not show any further signs of life. The main question in the trial was whether this tremulous motion of the lips was a sufficient proof of the child having been born alive.

The case of *Brock* v. *Kelly* involved a claim by a widow to the estate of her husband, on the ground that a child born twenty years before had been born living, although it was at first supposed to have been still-born. The decision of Stuart, V.-C., in 1861, confirmed the views here expressed. Freeman noticed at the birth of the child, and after separation from the mother, that there was a slight pulsation in the cord, showing a feeble but independent circulation. There was no other indication of breathing than an arched state of the chest. He had, it appears, made an entry in his diary of the birth being that of a *live* child, and believing it to be alive, he caused it to be placed in warm water to sustain its vitality. He felt sure of its being alive, for the reason above assigned. This statement was confirmed by the nurse, who had been heard to say that the child was born alive, but died the same day. This may be regarded as strong evidence that the child was really born with life.

At the time these observations were made, namely, twenty years before, the legal question of live birth was not raised, and there could have been no conceivable motive for mis-stating the facts or for inventing a state of things to suit a legal claim.

Rare as these cases are, one has been the subject of two trials.

Llewellyn v. *Gardiner and others*, Stafford Lent Ass., 1854; *Gardiner* v. *Llewellyn*, Stafford Sum. Ass., 1856. This was an action of ejectment brought to try the plaintiff's right to a life-interest in the property of his deceased wife. The plaintiff claimed as tenant by the courtesy of England, and his right depended upon whether his deceased wife had had a child born alive. According to the plaintiff's evidence, his wife had taken a long walk, she being at the time in about the seventh month of her pregnancy; and, having been taken ill during the night, she was suddenly delivered of a child, which lived for about a quarter of an hour. He stated that he heard the child cry. The plaintiff immediately fetched his sister, and returned with her to his wife in a few minutes, and she deposed that she heard the child cry twice. This evidence was relied upon as conclusive that the child had been born alive, although it appears on the same evidence to have died before anything could be done towards dressing it. The case for the defendants at the first trial was that the wife was a girl of delicate health and liable to epileptic fits; that when little more than 16, she had been married to the plaintiff, without the consent of her mother; and evidence was given to show the improbability of the child having been born alive, there being reason to believe, from the conduct of the plaintiff and other circumstances, that it never could have had more than a fœtal existence. There had been no medical examination; the body was buried the same day, and, as in the case of still-born children, neither the birth nor the burial was registered.

Wightman, J., left it to the jury to say whether the positive evidence given by the plaintiff and his sister had been rebutted by the evidence given for the defendant and the other circumstances of the case. The jury found a verdict in favour of the husband's claim. At the second trial, ordered by the Court of Chancery (Stafford Sum. Ass., 1856),

the plaintiff was made defendant; and medical and other evidence was adduced to show that the child could not have reached an age at which it could either breathe or cry. The age was variously assigned at the fourth or fifth month of gestation. The body of the child was not seen by any medical man, and the non-professional witnesses who saw it differed entirely regarding its size and appearance; so that, in fact, the case rested mainly on the credibility of the statements of Llewellyn and his sister. There were no *medical* facts to guide the jury.

Alderman, B., in directing the jury as to the considerations that should guide them in coming to a conclusion, said they ought to have reasonable and distinct proof of a child having been born alive when its existence was limited to a few minutes; and if a doubt was left in their minds, they ought not to find in favour of the defendant, because the issue lay with him to prove that the child was born alive. If they had a doubt on the subject, and could not tell whether it was born alive or not, they must find a verdict for the plaintiffs; they could not find for the defendant unless they were satisfied that the child was in a state of life in this world during the time the husband was married to the wife. The verdict of the jury was to the effect that they did not believe the child was born alive, and was, therefore, a reversal of the former verdict.

Monsters.—The connection of monstrosity with medical jurisprudence has been most ably investigated by St. Hilaire (" Ann. d'Hyg.," 1837, vol. 1). Although legal questions connected with monstrous births do not often occur, yet a medical witness should be acquainted with certain facts respecting them. The law of England has given no precise definition of what is intended by a *monster*. According to Lord Coke, it is a being " which hath not the shape of mankind; such a being cannot be heir to nor inherit land, although brought forth within marriage." A mere deformity in any part of the body, such as supernumerary fingers or toes, twisted or deformed limbs, will not constitute a monster in law, so far as the succession to property is concerned, provided the being still have " *human shape*." Even a supernumerary leg would not probably be allowed to avert an inheritance. A monster, in which the third leg was a fusion of two legs, was exhibited in London in 1846 (*Med. Gaz.*, vol. 37, p. 619). From Lord Coke's description it is obvious that the law will be guided in its decision by the description of the monstrous birth given by a medical witness. It would not rest with a witness to say whether the being was or was not a monster—the court will draw its own inference from the description given by him.

Various classifications of monsters have been made, but these are of no assistance whatever to a medical jurist, because each case must be decided by the peculiarities attending it; and his duty will not be to state the class and order of the monster, but simply in what respect it differs from a normal human being. In consequence of the want of a sufficient number of precedents on this subject, it is difficult to say what degree of monstrosity would be required in law in order to cut off the civil rights of a being (*vide Lancet*, 1, 1872, also *Lancet*, 1869, vol. 1, for an account of Chang and Eng, also *Lancet*, 1, 1871, p. 725). For a few other cases of monsters *vide* previous editions of this work.

Malpositions, transpositions, or defects of the internal organs of any of the cavities, do not form monstrous births within the meaning of the English law. The legal question relates only to *external* shape, not to *internal* conformation. It is well known that many internally malformed persons live to a great age; and it is not until after death that malposition and defects of this kind are discovered. One test of monstrosity has been based on the viability of offspring. According to some authorities a monster implies such a malformed being that the child would be pronounced non-viable, *i.e.*, incapable of continuing to live after it was born (Horn's *Vierteljahrsschr.*, 1865, 2, 264). Some medical jurists have discussed the question of "*viability*" in new-born children, *i.e.*, their healthy organisation, with a capacity to continue to live, as if it were part of the jurisprudence of this country; but the author was not aware of any facts which bear out this view. The English law does not regard *internal* monstrosity as forming a bar to civil rights; and the cases of *Fish* v. *Palmer*, of *Brock* v. *Kelly* (1861), and of *Llewellyn* v. *Gardiner*, show clearly that the simple question in English jurisprudence is, not whether a child is or is not "*viable*," but whether it has manifested any distinct sign of life after it was entirely born. The French law is much more complex, and throws a much greater degree of responsibility on French medical jurists. No person is justified in destroying a monster at birth.

There are some other legal conditions which are required to be fulfilled in order to establish a tenancy by courtesy, but our remarks are confined chiefly to that which may become matter for medical evidence.

Plural Births.—This has been regarded as a subject appertaining to medical jurisprudence; but we are not aware that there is any case on record in which the evidence of a medical man has been required respecting it. It is a simple question of primogeniture, which has been generally settled by the aid of depositions or declarations of relations or servants present at the birth. Of course in the absence of eye-witnesses the question of priority of birth must be a matter of conjecture. It cannot be determined by the size of the child. Women may have two, three, four, or five children at a birth. Twins are comparatively frequent, but triplets and quadruplets are very rare.

Guthrie stated that in the Museum of the Royal College of Surgeons of England "there is a large bottle containing five young ladies and gentlemen, all brought forth at one birth, and destroyed by an accident."

[This is probably a record—but it has no medico-legal interest; the curious are referred to works on "Obstetrics."—Ed.]

The only circumstance with respect to these plural births, which it has been recommended that an accoucheur should attend to, is the order of their occurrence, and whether any or all of them manifest signs of life after birth. The first-born male child, according to an ancient principle of the common law of this country, succeeds to the inheritance. In case of twins or triplet males, a practitioner would find himself much embarrassed, after the lapse of a certain period, to express an opinion as to which was first born, unless there was some personal peculiarity or deformity which would at once enable him to stamp the identity of a child.

LIVE BIRTH.

Accepting the definition of birth as "completely external to the mother," we have now to inquire into the meaning of the word "live" as regarded by the law.

Mr. Stanley B. Atkinson gives the following very lucid summary of the position (*Law Quart. Rev.*, April, 1904):

"There is no authorised definition of a *live-born child*. The terms of the definition of *murder* are suggestive.

"A child is *live-born* in the legal sense when, after entire birth, it exhibits a clear sign of vitality, that is, in practice, at least the evanescently persistent activity of the heart. *Vitæ habilitas* (*viabilité*) need not be proved in English law.

"Positive proof of the alleged live-birth of a given, now lifeless, child is necessary in law. Where respiration was never fully established, in the large majority of cases, it is essential for one present at the delivery to give direct evidence, as well of the complete birth, as of the subsequent exhibition of a sign of life.

"In Law (civil and criminal alike).

- Theory demands a *post-natal separate and independent existence in law*, i.e., *a separate personality*.
  - (? the fœtus having passed mid-term.) Homicide of the unborn is impossible.
  - Mr. Justice Wright's test: "whether the child was carrying on its being without the help of the mother's circulation," after birth (1901).
- Practice requires a post-natal sign of this separate existence:
  - 1.—Direct (*e.g.*, civil cases): at least palpable pulsations in the funis.
  - 2.—Indirect (*e.g.*, infanticide at birth in solitude).
    - (*a.*)—*Medical:* A pool of fœtal blood pumped from a wound (*e.g.*, divided funis).
      - Vital action of muscles of respiration or deglutition.
      - The common lung tests.
    - (*b.*)—*Moral:* Relative to the conduct of mother.

"In Medicine.

- Theory demands the cessation of the symbiosis between mother and fœtus. (? when does this actually occur. ? is the separation of the placenta a true test.) This dissociation may precede birth.

PRACTICE varies: unless respiration has been established it is not usual to *register the birth*."

For the guidance of midwives in notifying stillbirths under the Act of 1902, the Central Midwives Board has laid down that "a child is deemed to be stillborn when it has not breathed nor shown any sign of life after being completely born," on which the *Lancet*, 2, 1904, p. 93, remarks, "as the Board's rules have been approved by the Privy Council, this may be said to be an authorised if not a legal definition of stillbirth."

WAS THIS CHILD BORN ALIVE?

For civil, as well as for criminal, law an answer to this question is so important that it is necessary to go very thoroughly and completely into the sources and facts of evidence, and to discuss fully the nature and value of the deductions which may legitimately be drawn from them.

For the sake of clearness and to facilitate reference, the following table is given of the sources whence evidence of life may be drawn:—

1. Breathing; has this child breathed?
    - (*a*) shape of chest.
    - (*b*) position of diaphragm.
    - (*c*) air in the guts.
    - (*d*) " " " lungs.
2. Crying.
3. Muscular movements.
4. Circulation and heart-beat.
5. Contents (other than air) of guts.
6. Umbilical cord.
7. Skin.

The nature and value of the facts ascertained and the deductions to be drawn will be found under each heading, and a brief summary will close the subject.

HAS THIS CHILD BREATHED?

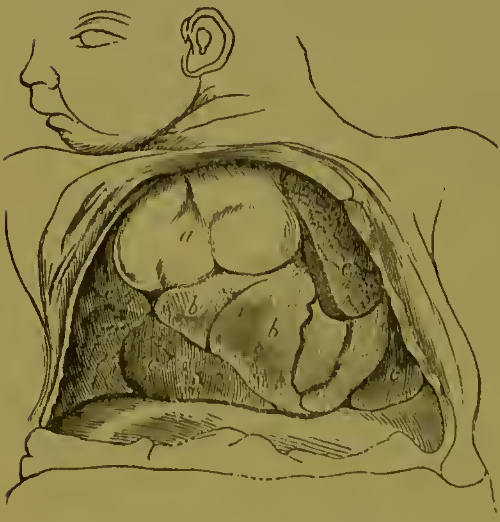
We put breathing first because it is the first thing that a new-born child proceeds to do, but in importance, as proof of live birth, it comes last. Formerly a very different view was held owing to imperfect appreciation of what it could prove. For instance, in *Brock* v. *Kelly*, Lee and Ramsbotham gave their opinion, and they were supported by Anstie, that nothing less than breathing could establish the fact of live birth. We shall see how far removed this is from modern opinion.

(*a*) **Evidence from the shape of the Chest.**—It is said that before respiration the chest is flattened, while after that process it is arched in front. The diameters of the cavity have been measured and certain comparisons instituted (Daniel), but these experiments have been attended with no practical results. Admitting that such a visible change of form is produced by respiration, it is obvious that in these cases experiments on the lungs may be readily made; and on the results of these, and not upon minute changes in the shape of the chest, would a medical opinion be based.

(*b*) **Evidence from the position of the Diaphragm.**—The position of the diaphragm should be determined by passing the fingers up into its dome through an abdominal incision before the chest is opened. In children who have not respired the diaphragm rises in the chest to the level of the third, fourth, or fifth rib; after respiration it sinks a good deal and rises only to the fifth, sixth, or seventh rib. On opening the chest the degree to which the diaphragm is covered by the lungs should be noted, for the more the lungs are filled with air the greater will this degree be.

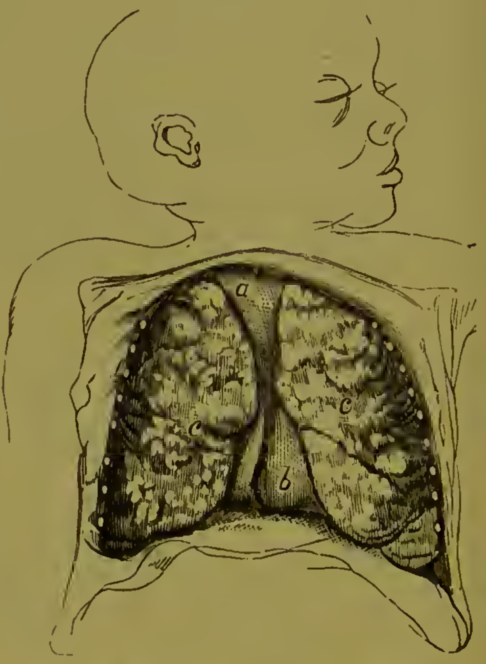
These small points are, however, merely slight corroborative details in estimating the value of the hydrostatic test results and need not be further discussed.

Fig. 1.



View of the organs of the chest before breathing. *a*. Thymus gland. *b*. The heart in its pericardium. *c c*. The lungs.

Fig. 2.



View after perfect breathing. *a*. Thymus gland. *b*. The heart. *c c*. The lungs.

(*c*) **Evidence from air in Stomach and Bowels.** — To perform the stomach-bowel test, place a ligature round the middle of the œsophagus and dissect it out with the stomach attached (take care not to incise the viscus by accident), continue the dissection to the lower end of the duodenum, place a second ligature round this, remove *en masse* the piece of intestinal canal between the two ligatures and throw it into water. If it sinks there is no air in the viscus, if it floats there is air in it; such air has arrived there either in the process of breathing or swallowing, hence the rationale of this proceeding is to corroborate hydrostatic lung test; thus if the piece of viscus removed sinks in water it is suggestive of want of active respiratory efforts on the part of the child, corroborating atelectasis. If, on the other hand, it floats, this indicates (i.) natural respiration or (ii.) artificial respiration or (iii.) gases of decomposition: if evidence of the last two be wanting, we then get corroboration of the floating aspect of the hydrostatic lung test, and it may be noted that the further down the canal air has passed the stronger the presumption of natural or artificial respiration. If the indications of lung and bowel are in opposite directions the lung is the more trustworthy.

There is no reason to doubt these facts and the very limited deduction as to breathing that may be made from them. No conclusions whatever are to be drawn from them as to "born alive" or "born dead" or "dead directly at birth."

(*d*) **Evidence from the Lungs.**—The cavity of the chest in a new-born child may be conveniently laid open in a manner somewhat different to that in ordinary use, as follows:—After reflecting the soft tissues from the front of the chest in the ordinary way the clavicles and the ribs should be cut through at about the middle of their length and the whole flap of tissue thus formed (of ribs, clavicles, and sternum) should be turned downwards without separating the diaphragm from its attachments.

The illustrations, Figs. 1 and 2, will serve to show the difference in the relative position of the organs of the chest, in a new-born child before and after respiration. If a child has *not breathed*, the appearances will be seen as in Fig. 1. The thymus gland, as large as the heart, occupies the upper and middle portions of the cavity; the heart within its membrane (pericardium) is situated in the lower and middle portion, and is rather inclined to the left side. The lungs are placed quite in the back part of the chest, so as often to give the impression that they are wanting. In some instances they project slightly forwards by their anterior margins; but in no instance, unless congested, infiltrated, or otherwise diseased, do they cover and conceal the heart. The thymus gland is sometimes of a pale fawn, at others of a deep livid colour; but there is no appreciable difference in this organ in new-born children, before or after the performance of respiration.

We have now to see what difference is produced in the chest, or rather in the lungs, as the result of respiration; they may be thus tabulated for completeness, but the import of the changes is a very varying quantity.

Synopsis of Points in the Lungs.

NOT BREATHED.	BREATHED.
1. Volume small, tucked up behind the heart.	1. Volume larger, more or less cover the heart.
2. Margins sharp, mass solid.	2. Margins rounded, mass spongy.
3. Colour of chocolate, and uniformly so all over.	3. Lighter in colour and mottled; great stress is laid by some experts on this mottling or unevenly-coloured appearance.
4. Vesicles want a lens to see them on the surface.	4. Vesicles are visible almost to the naked eye.
5. Does not crepitate under the finger on squeezing.	5. Crepitates on squeezing.
6. If on squeezing under water any bubbles of gas escape, these are large and uneven in size and due to gases of decomposition.	6. On squeezing under water the bubbles produced are small and uniform in size.

Synopsis of Points in the Lungs—continued.

Not Breathed—*continued.*	Breathed—*continued.*
7. Very little blood can be squeezed out of them, and what can be so squeezed is not frothy, unless it stinks from decomposition.	7. Full of blood, and what is squeezed out is frothy, without smell of decomposition.
8. Weight less.	8. Weight more.
9. Sink in water.	9. Float in water.

1. **Volume of the Lungs.**—The difference in the relative situation of the lungs before and after respiration depends entirely upon the increased volume or dilatation of the organs, arising from the introduction of air. *Before respiration*, the lungs are in general scarcely visible, unless forcibly drawn forwards in the chest. When it has been perfectly accomplished, the volume is so much increased, that the bag of the heart (pericardium) is almost concealed by them. Respiration must, however, have been very perfectly performed in order that this condition should exist to the full extent described; but the lungs may acquire a considerable volume in a healthy and vigorous child from only two or three respirations. A child may also live for one or two days, and the volume of the organs be but little altered. Schmitt has remarked, that the lungs have sometimes a considerable volume before respiration. The author met with this in more than one instance; but this condition will be found in general to depend on disease. As the altered volume of the healthy lungs depends on the introduction of air, the effect is very much the same whether the air be derived from the act of natural breathing, from artificial inflation, or from putrefaction.

2. **Margins of the Lungs.**—These alter in sharpness naturally with the blowing up or expansion of the lungs with air, becoming quite rounded with complete expansion.

3. **Colour of the Lungs.**—The colour of the lungs *before respiration* is brown-red, bluish, or deep violet; but it is subject to variation. Some medical jurists have compared it to the colour of the spleen. It is important to remark, that a very short exposure to air will materially brighten the colour of the lungs in the parts exposed, so that it should be observed and recorded immediately on opening the chest. *After respiration*, the lungs acquire a light red hue in proportion to the degree in which the process has been performed. If imperfectly established they will be mottled, generally about the anterior surfaces and margins; the patches of light red being intermixed with the livid fœtal hue, and being slightly raised, as if by distension, above the general surface of the organs. The light red tint changes, after a short exposure to air, to a bright scarlet.

Artificial introduction of air by a tracheal tube or otherwise, in the attempt to resuscitate a still-born child, is attended with the same physical change. In the course of numerous experiments, purposely made, the author found no appreciable difference. The author not only observed this colour to be absent after respiration, but has actually produced it by artificial inflation in the lungs of a dead child.

The red colour depends on oxidation of the hæmoglobin of the blood, it is a simple chemical phenomenon, and as such is independent of *how* the oxygen got there.

4. **Development of Air Vesicles.**—On the right (more commonly) lung, and especially on the edges and concave surface of its upper lobe, the first appearances of respiration may be visible, even when the rest of the lungs retain their fœtal condition. Here it is that the highly characteristic developed air-cells are first visible. These, if the lungs are fresh and full of blood, take the form of bright vermilion spots; but if the lungs contain less blood, or are examined some days after death, the spots are of a lighter tint. The form and arrangement of these cells are also characteristic; they are angular, and are not perceptibly raised above the surface of the lung. They may be either irregularly grouped, or arranged in sets of four or five; and their outline is distinctly polygonal. They are best seen with the naked eye, or at most with a lens of low power. Their form, their immobility when the finger is passed over the surface of the lung, their colour, and the fact that they are not raised above the surface of the lung, renders a mistake of these cells for the minute bullæ of putrefaction, melanotic spots, or minute ecchymoses, impossible, if ordinary care be exercised. The same development of air-cells may be brought about by artificial respiration.

5. **Consistency of the Lungs.**—The lungs, *before respiration*, feel like the liver, or any other of the soft organs of the body. They are firm under the finger, but their substance may be lacerated by moderate compression. *After respiration* has been fully performed, there is a distinct sensation of what is termed crepitation, on compressing them, *i.e.*, air is felt within them. This condition of the organs will, of course, depend on the degree to which respiration has been carried. The lungs of children that have lived for a considerable time after birth will sometimes give no feeling of crepitation under the finger. Generally speaking, lungs of this kind present the other fœtal characters: thus they are small and of a livid colour. There are, however, cases in which the lungs may have the light red colour of respiration, and be actually much dilated in appearance, yet no feeling of crepitation will be perceptible on pressure. This character therefore is by no means a necessary accompaniment of the other two. Crepitation furnishes a presumptive evidence of respiration; but it may be met with in lungs that are putrefied, or which have received air by artificial inflation. The characters here described are seldom found in the lungs of children that have been born prematurely, although these children may have lived some time after birth; they depend on respiration, and in the exceptional cases referred to this process is only slowly and imperfectly established. Independently of the feeling conveyed by the pressure of air, a section of the lungs, examined by the microscope, will enable the examiner to form an opinion whether air has or has not penetrated into them; in the former condition air-cells will be visible, and when the cut surface is pressed a bloody froth will escape.

6. If there can be appreciated any feeling of gas being in the lungs they must then be removed and **squeezed under water.** On squeezing a piece of healthy respired lung (infantile or adult) under

water, it will be at once noticed that the bubbles of air are all small and, speaking broadly, of the same size; whereas when decomposition is the cause of the gases being present the bubbles are uneven in size and they escape irregularly. In decomposition of the lungs it is also possible to see the air beneath the pleura and to move it from place to place in that situation by stroking with the finger or other instrument. It is thus easily possible by this means to distinguish the gases of putrefaction from those of respiration (*vide* also below, under *Hydrostatic Test*).

7. **Blood in the Lungs.**—It has been asserted that if blood is found in the pulmonary vessels of a new-born child, we are justified in assuming that respiration has taken place. On the other hand, the absence of blood from these vessels has been considered to prove that a child has not breathed. This assertion must have originated in a want of correct observation. The pulmonary vessels contain blood, both in the child that has and in that which has not breathed. It is possible that the vessels may contain more after respiration than before; but in most cases of infanticide it would be difficult to found any distinction on a point of this nature. The fact is, the excess of blood after the establishment of respiration is distributed throughout the smaller vessels of the lungs: it does not remain in the large trunks. The state of the larger pulmonary vessels, therefore, furnishes no evidence either of respiration or the contrary, but the blood which escapes on pressure from the lungs that have breathed is frothy, a point of very great importance if the source of the gases which make it frothy is known. The blood may be found coagulated or not, and there is no difference in this condition, whether the child is born living or dead.

8. **Weight of the Lungs, Absolute and Relative to Body Weight.**—Inasmuch as these tests have been put forth by medical jurists as tests of respiration they must be dealt with.

In order to determine the weight of the lungs, these organs should be carefully separated by dissection from the heart and thymus gland, and removed with the windpipe and bronchi attached. Previously to their removal, ligatures should be placed on the pulmonary vessels, so that no blood may escape from the lungs. They should now be weighed, and the weight accurately noted. In taking this weight it does not appear necessary to make any distinction founded on the sex of the child, or on the difference of weight in the two lungs; the only exception would be, perhaps, in relation to twin children imperfectly developed. The average weight *before respiration*, derived from nine cases, was found to be 649 grains. According to Traill, the weight varies from 430 to 600 grains. It is of importance in taking the weight of these organs to observe whether the child is at or near maturity and whether it is of or about *the average size and weight*: owing to a neglect of this rule, it is highly probable that comparisons have been made of the absolute weight of the lungs in children of different ages, which a full statement of the facts would not have justified. If it be small and immature, or unusually large, the lungs will weigh either less or more than the average. The average weight of the lungs *after respiration*, derived from three cases, was 927 grains. There does not appear to be any strict normal relation between the weights of the body and lungs in new-born children; it is certain that in the bodies of children of unusual weight the lungs will be found much heavier than the average, whether the child has breathed or not. The body may vary from six to eighteen pounds; the lungs under these circumstances will also differ in weight.

The healthy lungs of mature new-born children become heavier after respiration, and according to its degree; and where a deviation from this rule is observed it may probably be explained by the circumstance that the lungs of an immature have been compared with those of a mature child—the lungs of an undeveloped twin with those of one not a twin—or the lungs of one which has breathed imperfectly with those of another in which respiration has become well established. In this respect the extensive tables drawn up by Lecieux are liable to lead to erroneous inferences, relative to the effect of respiration on the absolute weight of the lungs. The weights of the organs are noted, but the *degree* to which respiration had been performed is so loosely stated as to allow of no fair inference of the effect of this process upon the weight. The time which the children survived is stated; but this, it is very well known, furnishes no criterion of the degree to which respiration has been carried. Again, we are not informed whether due care was taken to ascertain if the lungs were healthy or diseased ("Considérations sur l'Infanticide," Paris, 1819). The following table of the weight of the lungs, in four cases from the author's own observation, will show how much the organs are liable to vary in weight after birth, according to the *degree* of respiration:—

Case 1.	Born dead.	Weight, 678 grs.
,, 2.	Lived 6 hours	,, 774 ,,
,, 3.	Lived 24 hours.	,, 675 ,,
,, 4.	Lived 8 or 9 days	,, 861 ,,

Relying upon a table of this kind only, without comparing the other characters of the lungs with the weight, it might be inferred that the organs would weigh less in a child which had survived its birth twenty-four hours than in another which had been born dead, and that there would be very little difference in the weight, whether the child lived six hours or nine days; but when it is stated that in Case 3 the lungs had every fœtal character possessed by those in Case 1, and that in Case 4 respiration had been obviously very imperfectly performed, the difficulty is removed. Such cases should rather be compared with the lungs in the fœtal than in the respired state. They merely show what is very well known to and admitted by all medical jurists, that there are some instances in which the fact of respiration cannot be determined by the application of the static or any other test to the lungs.

9. **The Hydrostatic Test.**—The specific gravity of the lungs, as a whole, is greater before than after respiration; for although the organs become absolutely heavier by the establishment of the process, this is owing, not to the air, but to the additional quantity of blood received into them. The air thus received so increases the volume of the lungs as to more than counteract the additional weight derived from the blood, and thus to diminish their specific gravity. Under these circumstances they readily float in water. The author found that the specific gravity of the lungs before respiration, *i.e.*, in the fœtal condition, varied from 1·04 to 1·05. They are about one-twentieth part heavier than their bulk of water. After respiration, the specific gravity of the lungs with the air contained in them was found in one experiment to be 0·94, *i.e.*, the organs were about one-seventeenth part lighter than their bulk of water. The introduction of a small quantity of air will render these organs buoyant in water, and an alteration in the volume of the lungs sufficient for this purpose would not be perceptible to the eye. It will be understood that the specific gravity of the intrinsic substance of the lungs is unchanged; the organs are rendered only apparently lighter by the air contained in their cells, on the same principle as a distended bladder. Hence it follows that the diminution of specific gravity will take place whether the air be derived from respiration, artificial inflation, or putrefaction. It is on this property of the lungs that the application of what is termed the *hydrostatic test*, or the *docimasia pulmonaris*, is founded.

How to Perform the Test.

The mode of performing the experiment is extremely simple. Having removed the lungs from the chest, they should be thrown, still connected with the trachea and bronchi, into a large vessel of water. If they sink it should be noted whether the sinking takes place rapidly or slowly. If they sink when thus united, the two lungs should be tried separately; for it is sometimes found that one, commonly the right, will float, while the other will sink. Supposing that both lungs sink, it will then be proper to divide each into twelve or fifteen pieces and place these pieces separately in water. On the other hand, the organs when placed in water may float; it should then be noticed whether they float high above the surface, or at or below the level of the water. Sometimes they indifferently float or sink. It will now be proper to separate the lungs, and determine whether the buoyancy is due to one or both. Each lung should be divided, as before, into fifteen or twenty pieces, and all the pieces thrown into the water. The pieces that floated and those which only sank gradually must now be collected, placed in a cloth and squeezed firmly (put under a board, for instance, upon which the operator leans or stands with all his weight), after which they must again be thrown into water and their behaviour noted: some may now sink which previously floated, while others may sink more rapidly, or again all may float. Some have recommended that the lungs should be placed in water with the heart and thymus gland attached; but there appears to be no good reason for this, since it is as easy to form an opinion of the degree of buoyancy possessed by the lungs, from the readiness with which they float, as by observing whether or not they have the power of supporting these two organs. We have now at any rate a complete record of the behaviour in water of both lungs, of each lung, and of every piece of each lung.

These paragraphs constitute the facts of evidence that the lungs afford us; we must now inquire into their value. It may be stated at once that this value is infinitely great to answer the question—Did this child breathe? but, *per contra*, infinitely small—in the absence of an eye-witness—to answer the much more important question—Was this child born alive? Indeed, for criminal law the matter is not worth discussion, but we think that in some future civil case the weight of cumulative evidence (*vide* Vol. I, p. 122) may be so great that a verdict may be allowed, and should, in our opinion, be so allowed to rest upon it. We must therefore consider all the points, some in less, some in greater detail.

(d i.) **The Volume of the Lungs.**—The changes in volume caused by respiration take place rapidly, if they take place at all, and complete expansion has been observed when the child has been known to have taken only a few breaths before death. Sometimes, *per contra*, they are found in their fœtal condition, though the child has been known to have survived birth many hours. We may meet then with every variety in the appearances between these two extremes: the act of breathing often requires a considerable time in order to be *fully* established, especially in those children which are of a weakly constitution or prematurely born. Hence the lungs will be found to occupy their respective cavities to a greater or less extent, and to cover the diaphragm and pericardium more or less, not according to the time that the child has lived, but according to the perfection with which the process of respiration has been performed. Thus although, as a general rule, the lungs are more perfectly filled with air in proportion to the time during which a child has survived its birth, yet this is open to numerous exceptions, and it is these which are an absolutely fatal bar to accepting this evidence as conclusive of live birth. For instances *vide* below under "The Hydrostatic Test," to which, indeed, this and the next four or five points are merely preliminary observations.

(d ii.) **Margins of the Lung.**—These require no discussion; we need only mention that for some reason—possibly want of lateral support, as in emphysema in adults—the margins are frequently rounded and distended, when large portions of the rest of the lung are still fœtal. Hence it is from the margins that those pieces are likely to come which float when we find the "hydrostatic test" (*q.v.*), giving us intermediate results, a point which might be noted.

(d iii.) **Colour of Lung.**—A red as opposed to a bluish purple colour indicates oxidised hæmoglobin, and therefore penetration of air, hence the more uniform the red colour the more perfectly has air penetrated; the less uniform (the more mottling), the less perfectly has air penetrated. Dr. Taylor knew a case in which a child lived twenty-four hours, breathing feebly, and yet its lungs on examination were precisely the colour of fœtal lungs. It will be found that the red parts float, the blue ones sink, in the "hydrostatic test," to which we must again refer.

(d iv.) **Visibility of Air Vesicles.**—Precisely the same arguments apply as to colour; the vesicles will be evident in the red parts and not in the blue; evident in those that float, not evident in those that sink.

(d v.) **Crepitation on Squeezing.**—Another minor point, but one about which there is this to be said, the manipulation of the lungs necessary to its exhibition is apt to drive air from a crepitant air-containing piece into one that was fœtal, hence careless manipulation may lead one to think that penetration of air has been more complete than is really the case. Care should then be taken not to use this test more than can be helped before resorting to the hydrostatic one.

(d vi.) **Bubbles of Air from Lungs Squeezed under Water.**—Care is needed here to note the size and unevenness of the bubbles that we may not mistake breathed air for the gases of decomposition; beyond this the test is merely subordinate to and corroborative of the "hydrostatic test."

(d vii.) **Blood in the Lungs.**—A point requires to be noted here as to the difference in result between sucking air into the chest by active expansion of its cavity and mere forcing of air into the chest, and by this means causing a passive expansion of its cavity. The former encourages circulation of blood through, as well as air entry into, the lung, by reducing the atmospheric pressure to which the outer surface of the lung is exposed inside the unexpanded chest; the latter has no tendency to reduce this pressure, but merely increases the counter pressure in the air tubes, and thus has a tendency to prevent circulation of blood through the lungs.

It is thus possible to conceive that we might get indications, from observing the amount of blood in the substance of the lung, as to the means used to stimulate respiration, differentiating between the skilled efforts of the accoucheur and the unskilled ones of a mother.

Evidence thus derived might influence our opinion of the results obtained from the "hydrostatic test" and suggest artificial respiration, but this would have no weight in deciding "born-alive" or not, except in so far that it suggests the probable presence of an eye-witness.

(d viii.) **Weight of the Lungs.**—The facts ascertained are here so very variable that no conclusions whatever can be drawn from this test. Lungs that have not breathed are sometimes found to be heavier than those of another child which had breathed, therefore at once it is proved that absolute weight is of no use. It is probable that the lungs of an infant have some relation to the weight of that infant, but this will not help us to show whether the child had breathed or not.

As to the relative weights of lungs before and after respiration, there can be no question but that respiration increases the weight of a lung; but the lungs before us are in one condition or the other (as proved by other means), and they cannot be made to alter into the reverse condition, so that it is beyond our power to say how much they may have gained by respiration, nor how much they would lose by a return to a fœtal condition. Hence we can only compare them with an average standard, which is not of the slightest use in such grave issues.

The only conclusion is, then, that the weight of the lungs relative to the weight of the body or absolute in grains is utterly useless as evidence of "has this child breathed?"

(d ix.) **The Hydrostatic Test.**—This is a very old test, and to it all the preceding observations on the lung are merely a preliminary, one might say, of descriptive appearances rather than tests. The bare results of manipulation are three in number:

A. The lungs and every piece may float.

B. The lungs may just sink or just float, but of the pieces some float and some sink.

C. The lungs and every piece may sink.

A. **The Lungs and every piece thereof float freely, even after Pressure.**—This proves to a complete demonstration that air has penetrated freely to all parts of the lung; this penetration can only be due to (*a*) respiratory acts of the child; (*b*) artificial respiration by someone else; (*c*) putrefaction.

The last two alternatives are discussed below. We must here make a few remarks on the first alternative.

It would seem natural to suppose that such complete penetration of air indicates prolonged respiration, and therefore some considerable duration of life leading to a presumption that such duration was too great for complete birth not to have taken place. This presumption, we may say at once and finally, is not justified by facts. Witness the following case which came under Dr. Taylor's personal observation:—

In one instance the author found it impossible to expel the air when the child had lived to make no more than one or two respirations, and had died before it was actually born. On this occasion it was found necessary, in order to effect delivery, to destroy the child while its head was presenting. It lived, however, a sufficient time after the protrusion of its head, with the greater part of the brain destroyed, to cry loudly for an instant. The general appearance of the body showed that it had attained to the full period of gestation. On opening the chest, the lungs were seen projecting slightly forwards over the sides of the pericardium. They were of a light-red colour, but not crepitant under the finger. They had the external physical characters which these organs are known to acquire on the first establishment of respiration; but the absence of crepitation proved that the air-cells were not completely filled. The colour of the external surface was throughout uniform, a circumstance which the author never witnessed in lungs that had been artificially inflated, except when the inflation had been carried to its fullest extent out of the body. Then, however, there is commonly distinct crepitation. When removed and placed on water, the lungs floated freely; and, on being separated, both appeared equally buoyant. Each lung was next divided into sixteen pieces, and every piece floated. In dividing them, it was observed that the colour was uniform throughout their substance, but there was no sense of crepitation under the knife; and the cells in which the air was diffused could not be seen. The pieces were then subjected to forcible compression for some time in a folded cloth. The cloth was ruptured by the force employed; yet, on removing the pieces, and placing them on water, they all continued to float. A portion of air had, undoubtedly, been forced out, but not sufficient to deprive any of them entirely of their buoyancy. The compression was carried to the farthest possible limit consistently with the preservation of the structure of the lungs.

The position then is, that although there may occur cases in which the signs of full respiration may justify an opinion of live birth, such opinion will have to be fortified by other facts in addition before it can amount to conclusive proof.

B. **The Lungs just float or sink, but some pieces float and others sink.**—This condition is obviously due to less complete penetration of air and proves less vigorous respiration (*vide* below, X *b*, for its value).

C. **The Lungs and every piece sink.**—Obviously no permanent penetration of air, suggesting no respiration, but again *vide* below (Y *b*) for its value.

We must now notice :—

(X) Though the child has made efforts at respiration the lungs or fragments may sink from
  (*a*) intra-uterine disease of the lungs;
  (*b*) persistent simple atelectasis.

(Y) Though the child has made no perceptible efforts to breathe the lungs or fragments may float from
  (*a*) putrefaction;
  (*b*) artificial respiration.

X. THE LUNGS OR FRAGMENTS MAY SINK THOUGH THE CHILD HAS MADE EFFORTS AT RESPIRATION.

(*a*) **From Disease.**—Syphilitic affection of the lungs is known in new-born babies, and pneumonic or other consolidation is occasionally found; or, again, the lungs may possibly be œdematous from morbid changes in the circulation through them. None of these, however, can cause the medical jurist any real difficulty, for they all differ grossly from simple atelectasis or non-expansion, by the fact if air be blown into a lung through a tube it will at once expand in simple atelectasis, but will not in disease. It also feels tougher in disease, and cuts differently.

(*b*) **From Persistent Atelectasis.**—It is remarkable that life should continue for many hours, sometimes even for days, under such a condition; but, nevertheless, the occasional existence of this state of the organs (either as a whole or in patches) in a living child is placed beyond all dispute. Nay, more, it has been found that it is not necessary that the whole of the lungs should have received air in order that a child should continue to live for months after its birth. It is only necessary to quote three such cases (they are as good as 300), one twelve hours, another five weeks, and a third six months.

Donders made a post-mortem examination of the body of a child for one of his lectures on Forensic Medicine. The lungs were of a uniformly brown colour, placed rather on the side of the chest, with their edges superiorly. They both sank in water; the right was readily inflated; the left was cut into pieces, during which process no crepitation was heard or felt, and each piece sank in water. A knife passed with light pressure over the section expressed only a little reddish-coloured fluid. The bladder was empty. There was no meconium in the large intestines. There was no food in the stomach. The conclusions were—(1) an immature child of about seven months, still-born, which did not remain in the uterus, or only for a short time after death: (2) only a short time dead.

The error of this conclusion was subsequently demonstrated by the ascertained facts of the case. The child at its birth gave but slight signs of life, but on the employment of the ordinary means it soon began to cry in the usual way. For some hours it lay quietly moaning. In the evening it was of a bluish colour, but became more lively on the application of warmth. It soon grew cold and rigid, and died *twelve hours* after its birth.

A child, aged five weeks, died suddenly, and its death was attributed to an opiate, although the circumstances rendered it highly improbable that the child had died from poison. The body was in good condition. The lungs were found lying at the back part of the chest, inelastic, and presenting no crepitation in any part. They had the usual appearance of the unexpanded lungs of the fœtus. They weighed 1,080 grains. They sank in water, and when divided into many pieces no portion of them floated. It was difficult to inflate them, and the portions inflated readily lost the air by compression and sank. The microscope showed an absence of cellular structure. It is surprising how the child could have lived so many weeks with this state of the lungs; and it is obvious that under such circumstances a very slight obstruction to respiration would suffice to account for its sudden death (*Lancet*, 1868, 1, p. 870).

A child aged six months had been, it was supposed, destroyed by suffocation. Upon opening the chest the viscera were found healthy; but the whole of the inferior lobe of the right lung was, so far as regarded colour, density, and structure, precisely like the lungs of a fœtus, no air having ever penetrated into it. It had grown in size but never functionated.

Meckel relates two instances in which the lungs sank in water, but the women respectively confessed that they had destroyed their children ("Gerichtl. Med.," p. 365).

The cases given above demonstrate the fallacy of those medical opinions which have been given by some experts in civil cases, involving questions connected with live birth, inheritance, and tenancy by courtesy. Looking to the condition of the lungs alone, it is obvious that many children would be pronounced dead who were not only living when born, but had survived their birth many hours. Such a life, although not indicated by those changes in the lungs which are brought about by active respiration, must still be called extra-uterine.

Cases of the above description are beyond the reach of the hydrostatic as well as of all other tests applied to the respiratory organs.

The **explanations offered to account for the facts** are, according to Dixon Mann (" For. Med."), as follows :—Maschka and others deny that air enters the lungs at all in such cases; the passage of air along the trachea and bronchi is regarded as sufficient to account for the signs manifested during life. Others accept the theory first propounded by Simon Thomas—that in feeble infants the respiratory movements may gradually subside in such a way that the passive elasticity of the lung-tissue, at every respiration, drives out more air than is drawn in at the inspirations; in this way the lungs, after having breathed, gradually return to the fœtal condition. As the result of experimental investigation Ungar states that the air which has entered the *lungs may be entirely absorbed* after respiration has ceased by the blood circulating through them.

Possibly also the following may explain matters in some cases. A healthy full-grown child, recently born, may make an attempt at inspiration, but the closure of the larynx from spasm, or some irritant such as the vaginal discharges, meconium, etc., may impede the entry of air into the lungs. The chest in this case is arched, the head thrown back, and there is a convulsive rigidity of the muscular system; the tongue is firmly retracted, especially at its base. Unless the finger of the accoucheur is passed quickly down to the base of the tongue, and the epiglottis raised by pressing it forwards, the child would never inspire, although it might have a perfect capacity to breathe. Braxton Hicks met with a case of this kind: the air entered the lungs immediately after the above operation, and the child breathed and lived.

Any discussion on these explanations would be useless and out of place here when the facts themselves, with which alone a medical jurist is concerned, are attested by so many independent witnesses.

Y. The Lungs or Fragments may float though the Child has not made Efforts at Breathing.

(*a*) **From Putrefaction.**—The lungs of a still-born child, when allowed to remain in the thorax, are slow in undergoing putrefaction; but, nevertheless, they sooner or later acquire sufficient air to render them buoyant in water. This form of gaseous putrefaction may even take place in the lungs of a child which has died in the womb. One instance of the kind is recorded by Albert (Henke's *Zeitschr.*, 1837, 2, 179), in which the child was cut out of the uterus in a putrefied state, and its lungs floated when placed on water. It has been also alleged that the formation of air may take place in the lungs from putrefaction, and not be indicated by change in colour, smell, or other properties of the organs; but, admitting that this may occur, it can create no difficulty in the investigation.

When the lungs are putrefied, this will be determined, in general, by putrefaction having extended throughout all the soft parts of the body. The organs, according to the degree of putrefaction, will be found soft, of a dark green or brown colour, and of a highly offensive odour; and the serous membrane covering the surface will be raised in large visible bladders, from which the air may be forced out by very moderate compression. It has been remarked that, under the same conditions, gaseous putrefaction takes place as rapidly in the liver, heart, and thymus-gland of a new-born child as in the lungs. We should, therefore, examine the general condition of these organs and the body. The distension of the lungs with gas from putrefaction cannot be easily overlooked nor mistaken for the air of respiration. A case may possibly occur wherein the characters presented by the lungs will be such as to create some doubt whether the buoyancy of the organs is due to putrefaction or respiration ; or, what is not unusual, whether the putrefied lungs may not also have undergone the changes produced by respiration. The facts may be apparently explicable on either assumption. Other facts, under a proper investigation, may serve to remove any doubt. The answer to any objection founded on the putrefied state of these organs must at once suggest itself.

It may be that the medical witness cannot obtain satisfactory evidence from experiments on lungs in such a condition. He should then at once abandon the case, and declare that in regard to the question of respiration, medical evidence cannot establish either the affirmative or the negative. The fact of his not being able to give the evidence required cannot be imputed as a matter of blame to him, because this is due to circumstances over which he has no control. In a case of poisoning, the appearances after death in the viscera may be entirely destroyed by putrefaction ; but no practitioner would think of looking for proofs when the circumstances rendered it impossible for him to obtain them.

The hydrostatic test when completely applied as above described will distinguish putrefaction from respiration as follows :—

If such a piece of decomposing lung be firmly squeezed, as mentioned in the details of the test, the gas will be easily forced out, because, owing to decomposition, passage in any direction through the tissues is easy, and the lung will then sink. This is in contrast to the behaviour of a piece of respired lung (not decomposed), for in this case the air is only able to travel along the natural passages, and it is practically impossible, on applying moderate or even severe pressure (in the ordinary way), to avoid blocking some of the tubes in the middle, and so retaining some of the air in their distal parts; hence, short of pressure so severe as to destroy their texture altogether, the lungs will float by reason of this imprisoned air. When decomposition has advanced, the differences will disappear because the respired air in the tubes can find, equally with the gases of decomposition, a free passage in any direction.

(*b*) **From Artificial Respiration.**—If at birth a child does not voluntarily start breathing, artificial means should be adopted in order to resuscitate it. In all modern works on obstetrics two or three methods of performing artificial respiration are detailed (Schultze's is possibly the best), and for all of them are claimed cases of recovery from asphyxia neonatorum. The rationale of the proceeding is twofold—(*a*) to mechanically introduce into the lungs a sufficiency of air to expand them ; (*b*) to stimulate the dormant centre of respiration into activity, so that voluntary breathing may commence. That the latter part of the process is successful at times is proved by the very numerous cases of recovery, of which it is useless to give illustrations; the degree to which the former part is successful, or may be successful, is well illustrated by the following case, reported by Braxton Hicks :—

He delivered a woman of a full-grown child; it was still-born, and there was no effort at respiration. An attempt was made to resuscitate the child, but unsuccessfully, by blowing air into the lungs through a catheter. On inspection, the lungs were observed to be of large size, but they did not present the usual appearance of lungs which had breathed. Although about three-fourths of the organs had received air by inflation, they were of a pale-fawn colour, like the thymus gland. The air was contained in the minute air-cells. They floated on water as well as all the pieces (fifteen or sixteen) into which they were divided. Sir Thomas Stevenson's experience confirmed this observation. When compressed between the fingers under water small bubbles of air escaped; but no amount of compression short of destroying their structure caused these pieces to sink.

Hence it must be admitted that so far as pure medical evidence is concerned there is none which is really satisfactory to distinguish between lungs which have been partially (or even wholly) distended by artificial as opposed to natural means. Medical men must recognise this, and not attempt to stretch evidence beyond reasonable limits.

The importance of introducing the matter lies in the fact that a case is reported (Von Siebold in Henke's *Zeitschr. der. S. A.*, vol. 3, 1845) in which a child was found with its head cut off and the lungs contained air, but the mother asserted that this was due to her efforts at artificial respiration.

The inconsistency of the woman's statement as to the mode in which she inflated the lungs was clearly proved, and the examiners did not hesitate to give a decided opinion that the air found in the lungs had been derived from the act of respiration, and not from artificial inflation. This case shows that, when a theoretical objection of this kind comes to be tested practically, it ceases to present any difficulty. It may happen, however, that another person may inflate the lungs, and if the mother has been secretly delivered, she may be wrongly charged with murder (see case Casper's *Vierteljahrsschr.*, 1859, 2, p. 38).

A midwife here attempted to revive a child by breathing into its lungs after removal of its body from the soil of a privy, but the circumstances of the case were well known from the statement of the midwife.

Indeed, in all cases in which the question of artificial respiration can occur there will be the evidence of the person who performed it, or at least very good material for cross-examination of someone who alleges it was done, so that pure medical evidence on the subject is of very little value.

We see, then, that these changes in chest, diaphragm and lungs are capable of proving, and do prove collectively, the degree to which air has penetrated the substance of the lungs; they can and do prove whether such air was due to respiration (natural or artificial) or to putrefaction, but they cannot prove that this penetration was the result of breathing *after the child was completely born*, nor can they prove the negative that there was no life after birth, because there was no penetration of air and because the lungs were still fœtal in colour.

It is important to remember the above statements, which are now universally accepted, because medical jurists of repute have in former days expressed contrary opinions, basing them upon imperfect observation and inferences which are no longer justified in the face of modern knowledge and experience. Casper, for instance, assumed that all cases of secret delivery are rapid, a totally unwarranted assumption quite opposed to fact.

Dr. Taylor thus summed up the matter very briefly, but very much to the point.

Respiration Before or During Birth?—It has been already stated that the pulmonary tests are fitted to prove only whether a child has or has not *lived to breathe*. Neither the hydrostatic nor any other test can positively show that the body of a child was entirely *born alive* when the act of breathing was performed. As this is a subject which generally gives rise to some discussion in cases of child-murder, a few remarks are here made on it:—1st. Respiration may be performed while the child is in the womb, after the rupture of the membranes—the mouth of the child being at the os uteri (*vide vagitus uterinus*, p. 207); its occurrence, although extremely rare, rests upon undisputed authority. 2nd. A child may breathe while its head is in the vagina, either during a presentation of the head or of the breech (*vide vagitus vaginalis*, p. 207). It is not very uncommon, and it must be set down as a possible occurrence. 3rd. A child may breathe while its head is protruding from the outlet; in this position respiration may be as completely set up in a few moments by its crying, as we find it in some children that have actually been born, and have survived their birth for several hours. This is the most usual form of respiration before birth. In *vagitus uterinus* or *vaginalis* the lungs receive but a very small quantity of air; in respiration after protrusion of the head the lungs may be sometimes found moderately well filled, although never, perhaps, possessing *all* the characteristic properties of those which have fully breathed. The well-known occurrence of respiration under either of these three conditions strikingly displays the fallacy of making this process the certain boundary of extra-uterine life. A child may breathe in the uterus or vagina, or with its head at the outlet, and die before its body is born; the discovery of its having breathed would not, therefore, be proof of its having enjoyed what has been termed "extra-uterine life." The death of a child which has breathed in the womb or vagina, from natural causes before its entire birth, is a possible occurrence; but its death from natural causes before birth, after it has breathed by the protrusion of its head from the outlet, is an unusual event. All that we can say is—it may take place; but the death of a child under these circumstances would be the exception to a very general rule. Oberkamp, in four successive deliveries of the same woman, observed that the children breathed before delivery, but died before they were born.

It is now certain that, for criminal purposes at any rate, the law will assume—until the contrary appears from other circumstances—that the respiration of a child, established by the best of evidence, was carried on before it was entirely born, and not afterwards. Let the witness, then, in a case of alleged child-murder, ever so clearly establish the fact of respiration and therefore of life, at the time the violence was used, this evidence is not always sufficient. He is asked whether he will undertake to swear that the child had breathed *after* its body was entirely in the world. Unless he can go as far as this—which, for obvious reasons, he can rarely be in a condition to do—it will be legally assumed that, although the child had breathed, it had come into the world dead. It is quite necessary that medical witnesses should know what they are required to prove on these occasions.

In former editions of this work the reader can find full particulars of the following cases, all of which were decided in accordance with the above statement:—

R. v. *Poulton*, *R.* v. *Simpson* (Winchester March Ass., 1835), *R.* v. *Brain*, *R.* v. *Seller* (Norfolk Spring Cir., 1837), *R.* v. *Christopher* (Dorset Lent Ass., 1845), *R.* v. *Stevens* (Midland Circuit, 1853), *R.* v. *Taylor* (Hereford Sum. Ass. 1863).

In the August session of 1889 the editor heard the judge at the Old Bailey stop a case of infanticide very peremptorily. The medical evidence proved that every piece of the lung floated and that a cord was tightly tied round the child's neck, but the medical witness refused to swear that even such complete respiration had taken place after complete birth.

This is now the law for practical purposes, though probably a wrong interpretation of facts.

For respiration, however complete or incomplete, to be considered proof of live birth, an eye-witness to those respirations is essential.

Except possibly, indeed, under the circumstances of the next paragraph.

2. EVIDENCE OF LIVE BIRTH FROM CRYING.

It is quite certain that a child may breathe without crying, but it cannot cry without breathing, and this might therefore have been discussed in the next section but for one or two exceptional points.

In the first place, there is undoubted evidence that a child may utter a cry either in the womb or in the vagina (such a cry is known as *vagitus uterinus* or *vaginalis*), such cry being distinctly audible to bystanders, and has even been heard outside the lying-in room.

For a fully reported case of *vagitus uterinus* by Peiser, *vide Monatschr. für Geb. und Gyn.*, August, 1903, where fifteen well-authenticated cases are also referred to.

Secondly, in Scotland, for purpose of tenancy by courtesy (*vide* p. 186), it is required to be shown not merely that a child had breathed, but that the child had cried after it was born.

Beck remarks that the Scotch law is more precise than the English in thus demanding proof of *crying;* but it should be added that it is less just. The case of *Dobie* v. *Richardson* (Court of Session, 1765) is sufficient to prove this.

Dobie's wife brought forth a child about nine months after marriage which breathed, raised one eyelid, and expired in convulsions about half an hour after its birth, but *was not heard to cry*. The mother died in childbed, and the question was whether the *jus mariti* was not lost by the death of the wife within the year, without a child of the marriage which had been heard to cry.

The decree made in the case was that as the wife did not live a year and a day after her marriage, and as it was not proved that the child or fœtus of which she was delivered was heard to *cry*, the husband was not entitled to any part of his deceased wife's effects. (Beck's "Med. Jur.," 1, 358.)

The judges in this case did not stultify themselves by affirming that the child in question was born *dead*. This is a physiological and not a legal point. A child which died in convulsions half an hour after its birth could not be described as having been born dead. The law of any country may assume its own standard of life at birth. The Scotch law thus assumes "audible crying," but it cannot alter the physiological facts that a child may be born alive without crying. (See also the decision in the case of Blackie, Court of Session, 1833.) It was suggested that the proof of breathing should suffice, but by a majority the judges adhered to the old dictum of the law of Scotland, and decided that the only receivable proof of life in such a case was that the child had *cried*. They found that proof that a child was capable of motion, and that it had breathed for three-quarters of an hour, was not sufficient to establish live-birth.

Value of the Evidence from Crying.—From the result of the trial above it would appear that in Scotland its value is absolute, and provided there is good aural evidence, nothing more seems to be required to prove "live-birth," prenatal crying being ignored by the law apparently, although it has been heard by observers.

In England, on the other hand, it is undoubtedly a proof of life, and must be regarded as such, but to be regarded as a proof of live birth it is imperative that there shall be an actual eye-witness (as well as ear-witness) that the child cried after it was fully born. In the absence of such an eye-witness, any evidence of a cry will be merely of the same nature as evidence of breathing, and will be judged by the same rules (*vide* discussion in the previous section).

3. Evidence of Live Birth from Muscular Movements and Rigor Mortis.

The spasmodic twitching of the muscles of the mouth has been judicially regarded as a sufficient proof of live birth when noticed by a person in a child completely born (*Fish* v. *Palmer*, *supra*) *à fortiori*, therefore, the motion of a limb will be considered sufficient legal evidence of life after birth. It is to be observed that the length of time during which these signs of life continue after a child is born is wholly immaterial: all that is required to be established is that they were positively manifested. A child which survives entire birth for a single instant acquires the same civil rights as if it had continued to live for a month or longer.

In *Fish* v. *Palmer* the obstetric experts who were summoned to give evidence differed in opinion. Babington and Haighton stated that had the child been born *dead* or had the vital principle been extinct, there could have been no muscular movement in any part of its body; therefore the child had, in their opinion, been born alive, and had manifested some evidence of life after its birth. Denman, who was called for the defendant, dissented from this view. He contended that from the evidence the child had not been born alive, and in explanation of this, drew a distinction between uterine and extra-uterine life. He attributed the tremulous movements of the lips after birth to the remains of uterine life. The jury, however, under the direction of the court, pronounced by their verdict that the child had been born living, and the plaintiff thus recovered an estate of which he had been for ten years deprived.

From the result of this case it would appear that the English law does not recognise any distinction between uterine and extra-uterine life as drawn by Denman. The question is simply life or death—living or dead? Denman did not assert that the child was born dead. On the contrary, he assigned the movements observed by the witnesses to the continuance of life—but of *uterine* life.

In the light of modern physiology one feels that the verdict was probably right in law or equity, but doubtful in actual science. We know (*vide* Vol. I., p. 270) that after death in the popular sense the muscles will twitch or even contract under the influence of stimuli, from within or from without, therefore the child might have been dead when these twitches were observed, for they came well within the known period of time after death during which muscles are irritable and contractile. On the other hand, in the life of a very large number of children there is a time after complete birth during which they lie as though dead, but the subsequent efforts of the accoucheur prove that they were really alive; it is beyond the reach of medical science to say that this period of "suspended animation" did not exist in the child in question, and that it passed from this state into one of death, for not all children can be rescued from it.

It is, perhaps, inadvisable to have such subtle medical distinctions wrangled about in a court of law, and therefore we say, let the verdict turn on facts of movement, and accept them as signs of life, which they undoubtedly are,—of life in the muscles.

It must, however, be emphatically stated that actual proof of such movements having been seen must be demanded from an eye-witness before they can be accepted as reliable evidence of live birth; it is inconceivable that their past existence could be proved or even suggested by the minutest examination after death.

In the case of *R.* v. *Pill* (Dorset Sum. Ass., 1869) the body of the child was rolled in a quilt and placed in a drawer; some seventeen hours later cadaveric rigidity was found in the muscles. A medical man stated his belief that this was a proof of live birth, as he believed it would not have occurred had the child been stillborn.

We now know that such a belief is entirely erroneous; new-born children pass into rigor mortis after death whether live- or stillborn, and plenty of cases of actual ante-partum rigor mortis are reported. For one such *vide B. M. J.*, April 30, 1904, where it was known that the child was alive five hours before delivery (*vide* also Vol. I., where ante-natal rigor mortis is fully illustrated).

4. Evidence of Live Birth from the Circulation.

This will be considered as follows:—

1. Pulsations in cord and beating of the heart.
2. Changes in ductus arteriosus.
3. Changes in ductus venosus.
4. Changes in foramen ovale.

1. **Pulsations in the Cord and Beating of the Heart.**—If an adult's heart is beating he is not dead (*vide* Vol. I., pp. 270 *et seq.*); why, then, if a child's heart is beating should it be considered dead? Logic refuses an answer to such a query; the only difficulty lies in the fact that such pulsations leave no evidence of their occurrence.

In some instances, life may be indicated by the action of the heart, when owing to some accident the lungs cannot act. Efforts at respiration may be made, but the lungs will be found to contain no air. Cann met with a case of breech-presentation, in which the child appeared to breathe before its head was born.

As the head was large, considerable force was required in order to remove it. Artificial respiration was resorted to for twenty minutes after its birth, and, although the beating of the heart was felt during sixteen minutes of that time, no breathing occurred. It was found that the vertebræ of the neck were dislocated, and there was great effusion of blood around the spinal cord. The lungs were of a bluish-grey colour, as in the fœtal state. They were not crepitant, and did not float on water.

In 1849 a woman gave birth to a female child, as she believed, in the eighteenth week of her pregnancy. The child was supposed to be dead and placed aside. Some time afterwards Hurd's attention was called to it by some of the attendants, who had observed convulsive movements of the body. These continued for half an hour, and the action of the heart was evident to the eye from the pulsation it communicated to the chest as well as to the hand. There was no visible respiration at any time, but there could be no reasonable doubt that this child was *born alive.* In 1852, in attending another woman, Hurd noticed that the navel-string ceased to pulsate eight minutes before entire delivery. The child was born apparently dead: it was corpse-like in appearance, and its limbs were flaccid. By the aid of a hot bath, and inflation of the lungs continued for twenty minutes, the lips acquired a slight colour, and there was a feeble sigh. After the inflation had been continued for three-quarters of an hour, the lips and face became more tinged, and respiration was established.

This case is a further proof that the act of respiration is not necessary to the presence of life in new-born children. Any physician insisting on this proof would have pronounced this child to have been stillborn or dead, thirty minutes after its birth. The child was alive and well nine years after the birth. Braxton Hicks remarks that "those who consider respiration to be necessary to establish the true life of the new-born infant must admit also that under these conditions a child cannot be considered as a living one notwithstanding the heart is beating, that the attempts at inspiration are indisputable, and that the child is separate from the mother. On the other hand, under these circumstances, a child wholly born might be murdered, and yet there would be no evidence of inflation of the lungs to prove live birth" (*loc. cit.*). In the absence of marks of violence, cases of this kind could not involve a woman in a charge of murder. The non-establishment of respiration, and death subsequent to birth, would be the result of an unforeseen accident.

A case occurred in which a fœtus, born at the fifth month of uterine life, respired feebly and at intervals for about twenty-eight minutes. The child, which weighed only one pound and three-quarters, uttered no sound. The only evidence of life was in the action of the heart and the maintenance of the placental circulation. The latter gradually got weaker, and the moment it ceased, life appeared to be extinct. The entire lungs sank in water. When cut into pieces, only two small portions from the right lung floated.

In *Brock* v. *Kelly*, Tyler Smith supported the opinion of Freeman by an affidavit, considering that the fact that pulsation was observed in the umbilical cord after delivery was a physiological proof that the child in question was not born dead. It is clear that this child was born living—that it lived before the act of breathing, which after all was performed only in the most imperfect manner. The facts of this case are sufficient to show that the opinion given by Lee and Ramsbotham is untenable. The medical man and nurse present at the delivery were eye-witnesses not wanting in experience, and they were not likely to mistake a dead for a living child. The pulsation distinctly observed by them in the cord was a fact which showed that the heart of the child was contracting. Could the heart of a dead child pulsate or communicate its pulsations to an umbilical cord? Those who rely upon breathing only, or crying only, as a proof of life, must be prepared to affirm that convulsive movements of the limbs, lips, diaphragm, and body after birth, may take place in a really *dead* child. The Vice-Chancellor decided that proof of breathing was not necessary, and held that there was sufficient legal evidence of life after birth in the pulsation observed by the accoucheur. This decision is in accordance with common sense. Pulsations indicate an action of the heart, as much as motion of the chest indicates an action of the intercostal muscles. Why these accoucheurs should have maintained that there was life with contractility of the intercostal muscles, and not with a contractile power of the heart, is not apparent; but that the opinion expressed is in conflict with facts is proved by numerous cases described (see "Atelectasis"). It appears to have been forgotten that these suits generally take place many years after the birth of the child: in two cases quoted ten and twenty years elapsed before any question arose in reference to live birth. Such medical evidence as is here described to be necessary is simply unattainable. Our courts are obliged to decide these cases from the observations made by the accoucheur or nurses present at the delivery.

The following case, in which all the facts were accurately observed in reference to the manifestations of signs of life after birth, and the duration of life in a new-born child, clearly proves that the English courts are correct in relying upon proofs of life, irrespective of breathing or crying. It shows, too, that the decision of Stuart, V.-C., in the case of *Brock* v. *Kelly*, was based on sound physiological reasons, and that any other decision would have been unjust (*Amer. Jour. Med. Sc.*, July, 1870, p. 278).

Seale induced labour in a woman by ergot of rye, at about the seventh month of gestation. A large child was born after some difficulty, but it did not make the slightest-effort to breathe. There was distinct *pulsation in the cord*. Was this child iving or dead? As it had not breathed, according to some accoucheurs, it would be regarded as dead. The pulsation of the cord would be treated as of no importance, *i.e.*, as giving no indication of life after birth. But this child was really born living, a fact proved by what followed. Flagellation and alternate sprinkling with hot and cold water produced a violent spasmodic contraction of the diaphragm, which caused the entire infra-mammary region to be very much depressed. There was no doubt that this was a case of atelectasis pulmonum, a state which continued for *five minutes* after the birth of the child. The cord was now severed, and about half an ounce of blood was allowed to flow slowly from the fœtal end. The tongue, which had fallen back, was drawn forward. A sudden spirt of a drachm of blood flowed when the constriction was relieved, and the child began to breathe very freely, and so continued to breathe at long intervals. The heart beat very feebly. The pupils were widely dilated, they did not respond to the influence of a bright light, and the child was suffering from all the symptoms of compression of the brain. This condition lasted one hour, when the child ceased breathing.

According to the theories propounded in reference to the cases of *Fish* v. *Palmer* and *Broek* v. *Kelly*, this child would have been pronounced dead or stillborn up to the time at which the accoucheur removed the impediment to its breathing.

The best test to apply to such cases for the determination of *physiological* life is *auscultation*. The beating of the heart, as determined by the ear or the stethoscope, is an undoubted sign of life, in a physiological sense, whether the child breathes, cries, or moves, or does none of these. Bouchut noticed, on one occasion, that this kind of passive life continued in an infant for twenty-three hours after its birth. Feeble but distinct pulsations were heard at long intervals, but there was no motion of the ribs. Attempts at resuscitation were made, but the motions of the heart became more and more feeble, until they entirely ceased. An examination showed that the lungs had not received air. As we take the cessation of the heart's action to be the only certain evidence of death, so the existence of pulsation in the heart or arteries, when clearly perceived by the ear, stethoscope, or finger, is positive evidence of life in a physiological sense. Is this *legal* life? Would the wilful destruction of such a child constitute murder? Would this proof of pulsation without muscular motion, breathing, crying, or any other sign of active life, confer tenancy by courtesy, or transfer an estate by inheritance or survivorship? Bouchut justly observes that apparent death succeeding to birth, and characterised by the presence of a beating of the heart and an absence of respiration, is only a diseased condition of the new-born child; and, whether it is cured of this or dies, it is living, although it has not breathed; or, as a German jurist remarks, in these cases, "*Scheintod ist Scheinleben.*" By taking away its right of succession, the law punishes the child and its heirs for a malady with which it is born. They who contend that crying or breathing alone should be taken as a sign of life after birth would of course pronounce such a child to have been born *dead*, even at the time that they might be listening to the sounds of the pulsations of its heart (Casper, "Klin. Novellen," 1863, p. 564). Such pulsations would probably be referred by them to the remains of uterine life. [An absurd distinction.—Ed.]

2. **Ductus Arteriosus (Arterial Duct).**—It has been supposed that the state of the ductus arteriosus, ductus venosus, and foramen ovale would aid a medical jurist in forming an opinion whether a child had survived its birth. In general, as a result of the establishment of respiration, it is found that the communication between the auricles of the heart by the foramen ovale becomes closed; and that

the two above-mentioned ducts, after gradually contracting, become obliterated, or are converted into fibrous cords. Whatever may be the conclusions from experiments on the lungs, it has been contended that the closure of the foramen and of these ducts would infallibly indicate that a child had breathed. This inference, however, has been too hastily drawn. Researches have shown, however, that there are some serious objections to any conclusions based on the state of these fœtal vessels; their closure, as a natural process, always takes place slowly, and sometimes is not completed until many years after birth. Thus, then, in the generality of cases of infanticide, in which necessarily the child survives but for a short period, no evidence of the fact will be procurable from an examination of the heart and fœtal vessels.

The ductus arteriosus is a vessel about half-an-inch long, which in the fœtus forms a direct communication between the pulmonary artery and the aorta; it conveys the larger proportion of the blood from the heart to the aorta without passing through the lungs. So soon as respiration is established, its function is at an end, and it then begins to close.

Although the closure may take place as a result of the establishment of respiration, the time of its closure after birth is so uncertain as to render any evidence derivable from the non-closure altogether fallacious. The author examined the bodies of several children that had survived birth for some hours, and was not able to discover any perceptible alteration in the diameter of the duct either at its aortic or pulmonary end. In other cases partial contraction has been apparent. As the closure depends on a diversion of blood through the lungs, so it follows that, when respiration is feeble or imperfect, the duct will be found either of its natural patency, or, if closed, the closure must be regarded as an abnormal deviation. In the case of a child that died at the age of ten weeks, the ductus arteriosus was found to be freely open (*Med. Gaz.*, vol. 40, p. 994). Chevers has shown that there are numerous abnormal conditions which may give rise to non-occlusion of the duct (*Med. Gaz.*, vol. 36, p. 190; and vol. 38, p. 961; see also Orfila, "Méd. Lég.," 1848, 212). From the facts collected by Chevers it appears that the duct is liable to become contracted and even obliterated before birth, and before the child has actually breathed. In these cases there has been, in general, some abnormal condition of the heart or its vessels; but this, even if it existed, might be overlooked in a hasty examination: hence the contracted or closed condition of the duct cannot be taken as an absolute proof that a child has been born alive or survived its birth. In 1847 Chevers laid before the London Pathological Society the case of a child born between the seventh and eighth months, in which this vessel was almost closed, being scarcely one twelfth of an inch in diameter, and capable of admitting only the shank of a large pin. The tissues of the duct had altogether an appearance of having undergone a natural process of contraction; and its state proved that its closure had commenced previously to birth. In fact, the child survived only *fifteen minutes*; while, according to ordinary observations, the medical inference might have been that this child had lived a week. In this case the heart and lungs were in their normal or natural state (*Med. Gaz.*, vol. 39, p. 205). On the other hand the open or pervious condition of the duct is consistent with the child having breathed after birth; it sometimes remains pervious for many years. Peacock met with an instance in a man, æt. 30, in whose body the duct was found pervious, and of sufficient capacity to give passage to a writing-quill (*Med. Times and Gaz.*, 1861, 2, p. 514; also a case by Fagge, Guy's Hosp. Rep., 1873, p. 23).

The medical evidence derivable from the condition of the ductus arteriosus in a new-born child was submitted to a rigorous examination in the case of Frith (Ayr Circ. Court of Just., October, 1846).

The body of a child was found in a bag which had been buried in the sands on the seashore at Ayr, with such marks of violence about it as left no doubt that it must have been deliberately and intentionally destroyed. Independently of severe injuries to the throat externally, the mouth and throat internally were found to be so closely stuffed with tow and other substances that there was some difficulty in removing them. The body when found was much decomposed; the brain was pulpy, and the cuticle as well as the bones of the skull, were easily separated. The weight of the body was seven pounds, and the child had the characters of maturity. The prisoner had, beyond doubt, been delivered of a child about three weeks previously to the discovery of this body. It was alleged that this was her child, and she was put on her trial for the murder. The material question in the case was one of identity, depending on two sets of facts—ordinary and medical. The bag in which the body was found was part of the covering of a cushion belonging to the mother and grandmother of the child. This evidence so connected the prisoner with the dead body, that the medical facts raised in the defence became only of secondary importance. The following appearances were met with:—The heart and lungs weighed one ounce; the latter organs were collapsed; the right lung was considerably decomposed, and sank when placed on water; the left was of a red colour, firm in texture, and floated on the surface when immersed in a vessel filled with water; but on pressure there was no crepitation. The right side of the heart was filled with coagulated blood, the foramen ovale being partially open, and the *ductus arteriosus* impervious. The liver was large and of a leaden hue, the ductus venosus almost obliterated, and meconium was found in abundance in the lower bowel. The medical men were of opinion, from the perfect conformation of the child's body and the above-mentioned appearances, that it had been born alive. The circumstantial evidence established that not more than *five hours* could have elapsed from the birth of the child to the time at which its body was buried in the spot where it was subsequently found; and that, admitting it to have been born alive, there was the strongest reason to believe it did not survive its birth more than *ten minutes*. The results of experiments on the lungs were not alone sufficient to show that the child had been born alive. The organs were light, and not crepitant; the right lung was decomposed, and yet it sank in water, while the left was firm, and floated. The defect in this part of the medical evidence was, however, removed by the evidence of a man lodging in the prisoner's house, who deposed that he distinctly heard the child cry. He slept in the same room with the prisoner on the morning on which she was delivered. Under these circumstances, the defence taken up was that, considering the state in which the ductus arteriosus was found, this could not have been the child of the prisoner, because, if destroyed after being born alive, it must clearly have been destroyed immediately after birth. In that case the ductus arteriosus could not have been found impervious—*ergo*, the body found was not the body of the prisoner's child. It was contended that, according to all previous experience, the duct, except as a result of congenital disease, could not be found impervious in a child which had ceased to live within a *few minutes*, or even a few hours, after birth. One medical witness for the prosecution admitted that it required some days or weeks for the duct to become impervious; but a case was reported by Beck in which it had closed within a day. Another stated that it is generally a considerable time before the duct becomes closed. Medical evidence was given in defence, to the effect that the earliest case of closure was twenty-four hours; and from the state of the duct in this case, the witness considered that the child must have survived for one day at least, or not much less. Another witness stated that the discovery of the closure in a body would lead him to infer that the child had survived three or four days. According to this evidence the body produced could not have been that of the prisoner's child. The jury, however, found that the child had been born alive, but that murder had not been proven (*Med. Gaz.*, vol. 38, p. 897; *Edin. Month. Jour.*, November, 1846, p. 385).

It appears from the evidence given at the trial that circumstances quite irrespective of medical testimony proved that this child had been born alive, that it was the child of the prisoner, and that it could have survived its birth only a few minutes. The medical evidence left it undoubted that the child had been destroyed by violence. The facts that the mouth and throat were firmly packed with tow, and that there had been copious effusions of blood in the seats of violence, admitted of no other explanation. To what, then, was the early closure of the duct in this case to be referred? There is no instance on record of the arterial duct becoming *impervious* within a period of five or six hours (in this case only as many minutes could have elapsed) after birth. Its closure is naturally the result of free and perfect breathing in a healthy child; but the state of the lungs in this instance showed that respiration had neither been full nor complete. It is probable, therefore, that the case was similar to that described by Chevers, and that there was an abnormal condition of the duct. Either this must be assumed, or the closure must have depended on other causes than perfect respiration; but experience shows, as a general rule, that it proceeds *pari passu* with this process.

Admitting that this abnormal state of the duct, *i.e.*, its closure previous to birth, is in general accompanied by malformation either of the heart or of the great vessels connected with it, yet Chevers' case, already related, proves that this is by no means a necessary accompaniment. Hence, the better rule will be to place no confidence on a contracted condition of this duct as evidence either of live birth or of the time during which the child has lived. It can only have any importance as evidence when the death of a child speedily follows its birth; and these are precisely the cases in which a fallacy is likely to arise, for the contraction or closure may be really congenital, and yet pronounced normal. If a child has lived for a period of two or three days (the time at which the duct naturally becomes contracted or closed), then evidence of live birth from its condition may not be necessary; the fact of survivorship may be sufficiently apparent from other circumstances. Hence, this species of evidence is liable to prove fallacious in the only instance in which it is required, and the case of Frith shows the dangerous uncertainty which must attend medical evidence based on the closed condition of the duct.

3. **Ductus, or Canalis Venosus.**—This is the branch of the umbilical vein which goes directly to the inferior vena cava: there is no known instance of the obliteration of this vessel previous to birth. When respiration is fully established, it collapses, and becomes slowly converted, in a variable period of time, into a ligamentous cord or band, which is quite impervious. There is no doubt that in those cases in which it is stated to have become obliterated in children that could have survived birth only a few minutes or hours, the mere collapse of the coats has been mistaken for an obliteration of the canal. It is probably not until the second or third day after birth that its closure begins; although nothing certain is known respecting the

period at which it is completed. The condition of this vessel, therefore, can throw no light upon those cases of live birth in which evidence of the fact is most urgently demanded.

4. **Changes in Foramen Ovale.**—The foramen ovale is a large oval opening placed at the lower and back part of the partition between the right and left auricles of the heart. It is considered to attain its greatest size at about the sixth month.

At an early period of fœtal life there is no valve to the foramen ovale. About the twelfth week the valve rises upon the left side of the entrance of the vein, which thus comes to open into the right auricle. The separation of the two auricles is at the same time rendered more complete by the gradual advance of the valve over the foramen ovale, but the passage nevertheless continues open until after birth. Another valvular fold is formed on the right of the opening of the inferior vena cava, between it and the superior vena cava. This is called the Eustachian valve (*vide* Keith's "Embryology").

As a general rule, this valvular opening between the right and left sides of the heart exists during fœtal life, and becomes gradually closed after the establishment of respiration. It is, however, often found open in children that have survived birth several hours; and the period of its closure is as variable as in the case of the ductus arteriosus. Hence, it is not capable of supplying with certainty evidence of live birth in those instances in which this evidence is most required. Two subjects were examined at Guy's Hospital, one aged fifty, the other eleven years, and in both the foramen was found open; such cases are moderately common in the editor's experience. There is, however, another serious source of fallacy, which must be taken into consideration—the closure of the foramen ovale has been known to occur as an abnormal condition previously to birth and the performance of respiration. One case is mentioned by Capuron ("Méd. Lég. des Accouchemens," p. 337), and another is reported (*Med. Gaz.*, vol. 38, p. 1076). Other instances of this abnormal condition are adverted to by Chevers (*Med. Gaz.*, vol. 38, p. 967); and it appears that in these the arterial duct remained open, in order to allow of the circulation of blood not only before but subsequently to respiration. The children rarely survive birth longer than from twenty to thirty hours. Chevers observes:—"Cases of this description are of great importance in a medico-legal point of view, as they fully disprove the opinion maintained by many anatomists, that obliteration of the foramen ovale must be received as certain evidence that respiration has been established. It is assuredly impossible to deny that in the heart of a child which has died within the uterus, and has been expelled in a putrid condition, the foramen ovale may be found completely and permanently closed. In such cases as these it would, however, probably be always possible to determine, by an examination of the heart and its appendages, that the closure of the foramen had occurred at some period antecedent to birth." Still it would be unsafe in practice to rely upon the closure of this aperture as a proof of live birth, in the absence of other good evidence: and in no instance can its patency be regarded as a proof that a child has come into the world dead. In a medico-legal point of view, therefore, the patency or closure of this aperture possesses no longer any importance.

The circumstances connected with the closure of these fœtal vessels ive been statistically investigated by Elsässer. His facts prove that e vessels peculiar to the fœtal circulation remain open as a rule for me time after birth, and that it is not possible to determine accu- tely, by days, the period of their closure. He remarked that the sure commenced and was often completed in the ductus venosus fore it manifested itself in the other vessels. The complete closure, in far the greatest number of cases, takes place within the first six eks after birth, and the instances of obliteration before birth, or fore the period mentioned after birth, must be regarded as rare ceptions (*Med. Times and Gaz.*, 1853, 1, p. 531).

The result of this inquiry respecting **docimasia circulationis** is sentially negative: it either proves nothing, or it may lead a medical tness into a fatal error. It has been the more necessary to point t the serious fallacies to which it is liable, because medical jurists ve been disposed to place great reliance upon it, in cases in which dical evidence from the state of the lungs was wanting.

The presence of an eye-witness can no more be dispensed with if e-birth is to be proved by circulatory observations than in the case respiratory observations, in fact less so, for the changes left for covery by autopsy are capable of endless explanation by possible ra-uterine processes.

EVIDENCE OF LIVE BIRTH FROM THE STATE OF THE ALIMENTARY CANAL.

Good evidence of live birth may be sometimes derived from the covery of certain liquids or solids in the stomach and intestines, h as blood, milk, or farinaceous or saccharine articles of food; for is not at all probable that these substances should find their way o the stomach or intestines of a child which was really born dead.

Robinson has made some researches on the contents of the fœtal mach during uterine life. He finds that the substances which urally exist in the stomach of a fœtus before birth are of an uminous and mucous nature. His observations were made on the machs of two human fœtuses, and on those of the calf, lamb, and bit. The conclusions at which he arrived were:—1. That the mach of the fœtus during the latter period of its uterine existence ariably contains a peculiar substance, differing from the uterine uid (liquor amnii), and generally of a nutritious (?) nature. 2. That physical and chemical properties this substance varies in different mals, being in no two species precisely similar. 3. That in each al animal the contents of the stomach varies at different periods, in earlier stages of its development consisting chiefly of liquor amnii, which the other peculiar matters are gradually added. 4. That the uor amnii continues to be swallowed by the fœtus up to the time of h, and consequently after the formation of these matters, and their earance in the stomach. 5. That the mixture of this more solid nutritious substance with the liquor amnii constitutes the material mitted to the process of chymification in the fœtal intestines. He siders the contents of the alimentary canal to be chiefly derived from the salivary secretion, and that gastric juice is not secreted until after respiration has been established.

1. **Starch.**—In the case of a new-born child, Geoghegan discovered, by the application of iodine-water, the presence of farinaceous food in the contents of the stomach; hence the question of live birth was clearly settled in the affirmative. On another occasion, Francis employed this method of testing with satisfactory results, in a case in which the investigation was beset with unusual difficulties. He was required by the coroner to examine the body of a new-born child, found under suspicious circumstances. The examination of the lungs left no doubt that respiration had taken place; and the fact that the child had been born alive was fully established by the discovery in the stomach of a small quantity of farinaceous food (*Med. Gaz.*, vol. 37, p. 460). The quantity of starch present may, however, be too small to produce with water a solution which would be coloured by iodine in the usual manner. A portion of the contents of the stomach should then be placed on a glass slide, diluted with a little water if viscid, and examined under the microscope with a power of about 300 diameters. The granules (if present) may then be distinctly seen, having the shape peculiar to each variety of starch, and not unfrequently mixed with oil-globules and epithelial scales derived from the mucous membrane. By the addition of iodine-water their shape and size will be brought out by the intensely blue colour which they acquire. Blue fragments of an irregular shape indicate the presence of bread.

2. **Sugar.**—In one case which the author was required to examine, the presence of sugar was readily detected in the contents of the stomach by the application of Trommer's test. In order to apply this test, a few drops of weak solution of sulphate of copper should be added to a portion of the cold concentrated aqueous extract of the contents of the stomach. An excess of a solution of potash is then added, and the liquid boiled. If sugar be present, cuprous oxide is immediately precipitated of a yellowish or reddish colour. With cane sugar the same decomposition is effected very slowly. The formation of the red oxide of copper under these circumstances proves that some saccharine substance is present. In reference to the application of the sugar-test, however, it must be remarked that starch is easily convertible into a sugar by a chemical action of saliva or mucus, so that the test may appear to indicate sugar in small quantity, when the result may be readily due to the presence of some converted starch.

3. **Milk.**—This liquid may be found in the stomach of a new-born child, and may be identified microscopically in the fluids of the stomach by the numerous and well-defined oil-globules which it contains. It is not possible to distinguish human from cow's milk under these circumstances, nor is it necessary, for either has been introduced. When milk is present, milk sugar is generally found in the contents of the stomach by the sugar-test. The casein of milk precipitates cupric oxide from the sulphate; but on adding an excess of solution of potash the oxide is redissolved, forming a purple or violet-coloured solution. It is rapidly coagulated by the gastric juice, so that the casein may be found in small soft masses adhering to the lining-membrane of the stomach. It should be observed that albumen forms a deep violet-coloured solution with sulphate of copper and potash, but

the red cuprous oxide is not precipitated on boiling unless sugar is mixed with it.

4. **Epithelial Scales.**—The epithelial scales commonly found associated with articles of food in the stomach are of various shapes and sizes; they are flat, oval, or rounded, and sometimes polygonal. They are nucleated, and from their pavement-like appearance they are called "tessellated." If such are found clearly originating in the mouth, they prove an act of swallowing.

Besides the substances mentioned, other solids and fluids, such as blood and meconium (the fæcal discharges of the fœtus) may be found in the stomach of a new-born child, and a question may arise whether their presence indicates that the child was fully born. It is not impossible that a child might be fed and exert a power of swallowing when its head protruded from the outlet, and its body was still in the body of the mother. Children have been known to exert a power of sucking or aspiration under these circumstances, and with this a power of swallowing might be exercised. That the starch, sugar, or milk, etc., found in the stomach, should have been given to a child when the body was only half-born, is an improbable hypothesis. When the substances found in the stomach are not in the form of food, but are fluids connected with the child or the mother, the case is different. These may penetrate into the lungs or stomach during birth, either by aspiration or the act of swallowing: they thus indicate that the child was living, but they do not necessarily show that its body was entirely in the world when they were swallowed.

5. **Blood.**—An instance is related by Döring in which a spoonful of coagulated *blood* was found in the stomach of a new-born child. The inner surfaces of the gullet and windpipe were also covered with blood. Döring inferred from these facts that the child had been born alive; for the blood in his opinion could have entered the stomach only by swallowing, *after* the birth of the child and while it was probably lying with its face in a pool of blood. Taken alone, however, such an inference would not be justifiable from the facts as stated. Blood might be accidentally drawn into the throat from the discharges of the mother during the passage of the child's head through the outlet, and yet the child may not have been born alive. The power of swallowing may be exerted by a child during birth either before or after the act of breathing. This power appears to be exerted even by the fœtus in utero. For tests for blood *vide* Vol. I., pp. 129 *et seq.*, remembering that fœtal blood contains a proportion of nucleated red corpuscles.

6. **Meconium.**—The name meconium is applied to the excrementitious matter produced and retained in the intestines during fœtal life. It is a mixture of bile-coloured granules, of epithelium from the mucous membrane lining the intestines, of mucous matters probably derived from a destruction of the epithelial cells and of cholesterin crystals.

Gosse states that in the early stage of uterine life the alimentary canal contains merely a mucous liquid. At the third month there is a more copious secretion; a clear non-albuminous acid liquid is found in the stomach, and a soft chymous liquid is present in the small intestines. Up to the fifth month the small intestines contain meconium of a greyish colour. After this period the meconium becomes gradually of a deeper colour, and it passes into the large intestine. When the child has attained uterine majority, the meconium in the jejunum is whitish; in the ileum, yellow; in the cæcum, greenish-yellow; in the ascending colon, green with less yellow; and in the rectum green-black like poppy-juice (hence the name, from μήκων, "a poppy").

Meconium is generally discharged from the bowels of a child within forty-eight hours after birth, or at the latest on the third day. It then appears of the consistency of honey, of a very dark-green (almost black) colour, with very little yellow colouring-matter in it. It has no disagreeable odour. Its specific gravity is 1·148 ("Des Taches au Point de vue Medico-légale," 1863, p. 75). It may be found in the stomach of a new-born child, and a question will thence arise whether its presence there should be taken as a proof of entire live birth. It may be discharged from the child during delivery in cases in which there is a difficult or protracted labour. In the act of breathing it may enter the throat with other discharges, and thus be found in the stomach. That a breathing child can thus swallow meconium cannot be disputed, but, assuming that in the body of a child which has not lived to breathe this substance is found in the air-passages and stomach, how is the conclusion affected? In the following case Fleischer was required to examine the body of a new-born child which was said to have been born dead.

He found meconium in the large intestines (the colon and rectum), and a greenish-yellow-coloured liquid in the cavity of the stomach, in the larynx, windpipe, and gullet. In the air-passages it was in well-marked quantity. The lungs contained no air, but possessed all the usual fœtal characters. When cut into pieces and placed on water, all the pieces sank. It appeared that a woman was present at the birth, who observed that the child did not breathe, but was born dead. It was not bathed or washed, and no air was blown into its lungs. From the general appearance and properties of the liquid found in the stomach and air-passages, Fleischer had no doubt that it was meconium from the intestines of the child. It could not have been swallowed after the child was born, but must have been accidentally drawn into its throat by efforts to breathe during birth. Some of the meconium had probably been discharged from the bowels of the child during labour, and as the mouth passed over this liquid a portion was drawn into the throat by aspiration. When once there, the instinctive act of swallowing would immediately convey a portion of it into the stomach. The same remark applies to the urine.

As the facts connected with the birth were well known, this appears to be the only reasonable explanation (Casper's *Vierteljahrsschr.*, 1863, 1, 97; also for another case, *Med. Times and Gaz.*, 1861, 2, p. 116).

Meconium may be generally recognised by its dirty-green colour and general appearance, as well as by the absence of any offensive odour, which it does not acquire until after the third or fourth day from birth, when it becomes mixed with feculent matter. In the air-passages it is sometimes associated with vernix caseosa, and hairs derived from the skin (*Med. Times and Gaz.*, 1861, 1, p. 591; and 1861, 2, p. 116; see also "Ann. d'Hyg.," 1855, 2, p. 445).

But little need be said on its chemical properties; still, as the detection of stains of meconium on clothing may occasionally form a part of the medical evidence, a few observations are here required. The stains which it produces are of a brownish-green colour, very difficult to remove by washing. They stiffen the fabric, and are usually slightly raised above the surface, without always penetrating it. Meconium forms with water a greenish-coloured liquid, having an acid reaction, and a boiling heat does not affect the solution. Nitric acid, and also sulphuric acid and sugar, yield with it the green and red-coloured compounds which they produce with bile. Cholesterin may be separated from it by hot ether.

It may be remarked, in reference to stains produced by the fæces of a child which has survived birth, that until the fifth or sixth day they retain a dark-green or greenish-yellow colour. On the seventh day after birth, they generally acquire a bright-yellow colour, like that of the yolk of egg; and this colour, if the child is in health, they will retain during all the time that it is suckled.

The presence of stains of meconium on the clothing of a child has been considered, in the absence of any evidence from the lungs, to furnish sufficient proof that a child has been *born alive.*

In 1850 the body of a child, completely dried or mummified, was found concealed in a hollow space in the chimney of a house. From the dry state of the body it had apparently been there for a considerable time. Bergeret found it to have the characters of a mature female child. It was wrapped in linen, which was marked by two kinds of stains, some of a deep-green almost black (meconium) and others of a reddish-brown colour (blood). The internal organs had been completely destroyed, chiefly by larvæ of insects of which many of the dried chrysalis-cases were found. The skin was dried to a parchment condition. Was this child born alive? As the lungs were destroyed, Bergeret directed his attention to the meconium stains on the linen; and he concluded from these that, had the child died before or during labour, the greater part of the meconium would have been discharged before birth. Assuming that a quantity of it still remained in the bowels, this could not have been discharged from them, as a result of vital contractility after death. Further, the portion of linen around the nates of the child was not stained, hence there had been no discharge post mortem, after the dead body had been placed in the chimney—leading therefore to the conclusion that the linen had been stained by the natural discharge from a child born living, and previous to the disposal of its body. Bergeret also inferred, from the large quantity of meconium, that it had been discharged during a state of severe suffering resulting from a violent death ("Ann. d'Hyg.," 1855, 2, p. 442). He gave his opinion—1. That this mummy-child was mature; 2. That it was born alive, and that it died from violence soon after its birth; and 3. That its death probably took place about two years before the discovery of the body. The latter conclusion was based on entomology, *i.e.*, on the condition of the chrysalis-cases and the larvæ of the *Musca carnaria* found in the cavities of the body. The facts were such that, in Bergeret's opinion, a shorter period than two years would not account for the state in which the insects were discovered. A woman who had been, it was supposed, delivered of a child, was tried upon this evidence, before the Jura Court of Assizes, on a charge of child-murder. The jury acquitted her.

There was no evidence of live birth, for the stains of meconium on the linen might be accounted for irrespective of this theory. There was no evidence of murder, for all the facts admitted of an explanation on the assumption that the child had been either stillborn, or, if born living, that it had died from natural causes soon after its birth, and that its body had been concealed in the spot where it was found. Such a case only shows the silly lengths to which some people will go in their endeavours to escape from the "I don't know" by an apparent cleverness of deduction.

7. **Foreign Substances in the Air-passages and Stomach.**—Maschka met with the following case:—

A woman was secretly delivered of a child, which she alleged was born dead, but she did not produce its body until after the lapse of fourteen days, when it was found in such a state of putrefaction that no satisfactory evidence of live birth was obtained from the lungs. These organs, as well as the heart and liver, contained small bladders of air from putrefaction and floated on water.. On slight compression, the lungs sank. The air-passages, gullet, and stomach contained sand and excrementitious matter, which was pressed out of them on a section being made. The air-passages were so blocked up as to furnish a sufficient cause for the prevention of breathing and for death from suffocation. The woman, when charged with the murder of her child, confessed that she was suddenly delivered while having, as she supposed, an evacuation—that she fainted, and that when she recovered, she found she had been delivered of a child, which had fallen into the privy and was dead. The medical evidence was in accordance with this condition of the body. Maschka concluded that the child had come living into the world, and had died from suffocation. He drew this inference from the discovery of excrement and sand in the air-tubes, lungs, and stomach. He considered, from the appearances, that in the aspiratory effort to breathe (a living action) the child had drawn these substances into the lungs, and further, that they could have found their way into the stomach only by the act of swallowing. These actions could not have taken place until after birth, and in his judgment they clearly proved that the child had come living from the body of the mother (Horn's *Vierteljahrsschr.*, 1865, 1, p. 37).

In one case a woman was suddenly delivered of a child while sitting over a slop-pail of dirty water. On examining the body, it was obvious that it had not breathed. There was no air in the lungs, but a quantity of dirty water like that in the pail was found in the stomach. This could have entered the organ only by the act of swallowing, and, in Ramsbotham's opinion, the child had swallowed the liquid under some fœtal attempts to breathe. The coroner who held the inquest directed the jury that the child was born dead ; but most physiologists will consider that the power of swallowing cannot be exerted by a dead child ; and as its body must have been entirely delivered in order to have fallen into the liquid, there was proof that it had been born living, and that in this instance it had died after it was entirely born, by the prevention of the act of breathing.

The inference of live birth in these cases was based on good physiological grounds. The discovery of foreign substances, which from their nature could not have entered the body during delivery, is a good proof of entire live birth ; but we ought to be well assured that such substances could not have accidentally found their way into the body after birth. Thus it might be suggested in defence that they had penetrated into the stomach and lungs as a result of putrefaction, if the body is immersed in liquid. It will be for the examiner to determine, by a proper examination at the time, how far this can explain the facts. The discovery of excrementitious matter in the interior of the stomach and in the substance of the lungs was a proof that the child had exerted the living acts of swallowing and aspiration.

These principles may be applied in dealing with similar cases. In the last case there was the state of the lungs to help the conclusion. If the body of a child is so putrefied as to lay open the stomach and lungs so that foreign matters can have free access to them, it would of course be unsafe to base an opinion on these conditions.

The condition of the **urinary bladder**, whether empty or full, is of no medico-legal value ; it may be emptied before birth or at birth.

Value of Evidence from the Alimentary Canal.—From the above paragraphs we may sum the matter up thus. The value in general is great because the objects are there for us to see and analyse.

The value in particular varies with the nature of the material

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found and the consideration of the possible *source* of such material and the *reason* for its presence. Thus, the discovery of farinaceous food, milk, or sugar in the stomach will furnish almost conclusive evidence of live birth, since substances of this kind are not found naturally in this organ, and it is almost inconceivable that anyone should try to feed a dead baby or force food down its throat without there being evidence of such procedure.

The presence of natural fluids—such as *blood*, *meconium*, or the watery discharge attending delivery—in the stomach and air-passages of a new-born child, does not prove live birth, but merely indicates the existence of some living actions in the child at or about the time of its birth. It is otherwise with foreign substances, which according to their source will suggest the reason for their presence as by aspiration, etc.

6. EVIDENCE OF LIVE BIRTH, ETC., FROM THE UMBILICAL CORD.

As this is the first appearance of the umbilical cord in the forensic area there is no more convenient place in which to consider the evidence it is capable of giving from every side. The points which should be noticed about the cord in all cases are:—

1. Pulsations in it or their absence.
2. Mummification of it.
3. The line of separation at the navel.
4. The manner in which it has been severed.
5. Its total length if available.

1. **Pulsations in it.**—These, when present, are accepted as indubitable evidence of live birth (*vide* "Tenancy by Courtesy," *supra*), and their complete and continuous absence at birth would constitute equally sound evidence of "born dead" (*vide* p. 247). Such pulsations, or their absence, it is abundantly obvious, can only be sworn to by one who was actually in attendance at parturition, for it cannot for a moment be imagined that either their presence or absence for a few minutes would leave the slightest trace that could be discovered even by the most painstaking autopsy. The possible necessity of their being required for "tenancy by courtesy" should never be lost sight of by accoucheurs and midwives.

2. **Mummification of it.**—In a child that has been born alive, or has survived its birth for a period of from twelve to twenty-four hours, that portion of the umbilical cord which is attached to the abdomen undergoes certain changes: thus it dries and becomes slowly shrivelled, and in from three to five days it separates from the body with cicatrisation of the wound of separation.

The cord does not separate at the part which is tied, but close to the abdomen. It separates generally within five days, by a process of sloughing; the skin connected with the dead portion of cord presenting a red line arising from capillary congestion. During the separation of the navel-string the umbilical vessels are gradually closed. The obliteration of these vessels is effected in a peculiar manner. The calibre diminishes as a result of a concentric thickening of the coats, so that, while the vessel retains its apparent size, its cavity is gradually blocked up. A quill would represent the form of the vessel in the fœtal state, and a stem of a tobacco-pipe in the obliterated state. It is only by cutting through the vessel that the degree of obliteration can be determined.

The state of the *umbilical cord* has often furnished good evidence of live birth, when the other circumstances of the case were inadequate to furnish decisive proof. In the following instance it might have been suspected, but for the state of the cord, that the child had been stillborn, and that its lungs had been artificially inflated.

In consequence of some suspicion respecting the cause of death, the body of a child had been exhumed soon after burial. It weighed nearly five pounds, and was eighteen inches long; the opening for the navel was exactly in the centre of the body. The hair on the scalp was about an inch in length, and plentiful; the nails reached to the extremities of the fingers and toes. There was no mark of violence about it. The *navel-string had separated* by the natural process, but the skin around it was not quite healed. The tendon of one of the muscles of the leg was prominent, and apparently contracted at the instep. The left testicle alone had descended into the scrotum—the right was still in the inguinal canal. This rendered it probable that the child had not quite reached maturity. It was by the peculiarity of the instep that the body of the child was identified. In the first instance the body of another child had been brought from the same burial-ground, but rejected, from the absence of this appearance of the foot (*cf.* "Identity," Vol. I.). On opening the chest, the lungs were observed to be situated at the back part and not filling the cavity. They weighed together 861 grains—the right weighing 430, and the left 431 grains. The heart, thymus gland, and lungs were placed together on water, but they immediately sank. The lungs, when separated from the other organs, floated, but with a slight degree of buoyancy. Indeed, this was established by the fact that they sank with the heart and thymus attached. The lungs were cut into twenty-two pieces; three pieces from the apex sank; the remaining nineteen pieces floated, and they were not made to sink by pressure. The foramen ovale was contracted, as well as the ductus arteriosus, to about one-half of the fœtal diameter. The bladder was perfectly empty—the intestines contained only mucus.

The conclusions at the inquest were :—1. That the child had been born alive, and had lived certainly not less than three days, and probably longer. 2. That respiration during that time had been but imperfectly established. 3. That in all probability the child had died a natural death. The conclusions were well warranted by the facts. Experiments on the lungs were here not necessary, owing to the state of the umbilical cord. It was subsequently proved that the child had lived eight days after birth.

It is commonly stated that once such drying of the cord has appeared it cannot be removed by soaking in water. From experiments made by the editor in 1904, he is able to state that such is not in accordance with facts.

The dried piece of the cord of a child that died three days after birth was placed by him in a bottle of ordinary tap water for a week or more; at the end of this time it had resumed a supple appearance, and was still tough, but all traces of its being mummified had disappeared. He made many similar experiments with like results.

It is stated that if a dead born child be thrown into water the cord undergoes a liquefactive form of decomposition instead of mummification; this is probably true, as all observation and experiment show that the drying is a purely physical change, which, of course, cannot go on when the cord is submerged. It follows that if a child be removed from the water with a mummified cord attached to it, the evidence is complete that the child was kept in a dry place for a sufficient length of time for mummification to have taken place, and hence is corroborative in a very high degree of any other signs of live birth, though it must not be assumed that a dry cord is in itself proof that the child lived while the cord was drying.

3. **The Line of Separation at the Umbilicus.**—It is stated that even at birth a reddish ring may be noted at the insertion of the cord in the skin at the umbilicus (Tidy); this disappears after death, and must not be confounded with the line of inflammation, which appears about the third day at the point in the skin from which the cord will fall. The mummified cord, being dead tissue, is separated from the living skin of the infant by a process which in its totality is known as inflammation; this inflammation is as indubitable a sign of life as it is possible to get: when, therefore, this ring of inflammation is found on a dead child, we have at once complete and final proof of life for at least say thirty-six hours (it is probably nearer to seventy-two hours). The cord actually falls off owing to the changes in the tissues at the umbilicus at some period between the second and the tenth day, the fourth, fifth, and sixth days accounting for a very large majority of the cases; at its fall it leaves a small open wound which heals in two or three days' time. If then this wound, or suppuration, or a healed scar be found, we get further conclusive proof of life for a period to be measured by days, say from four to about twelve.

4. **The Manner of Severance of the Cord.**—This in itself is not a matter of very great importance, as a rule, either to the child or to the mother, but in a medico-legal inquiry on a dead child it may suddenly assume the very highest importance as a piece of corroborative evidence; it must, therefore, be most carefully noted and recorded.

The editor made many efforts to sever the cord by simple tearing, but such was the slipperiness of it that he never succeeded in doing so by simply twisting it round his hands, he had invariably to get some dry article with which to obtain sufficient purchase; in his efforts he noted that he forced the jelly, of which the bulk of its structure is formed, up into irregular heaps, so to speak, within the coverings of the cord; it might be important to notice this as corroborative of a woman's statement that she had thus severed the cord.

If again the cord is cleanly cut this would tend to set aside the explanation of the child having accidentally dropped from the female, because in such an accident the cord should be found *ruptured*. The practitioner should make a careful examination of the divided ends of the cord by the aid of a lens, or a rupture may be mistaken for a section with a sharp instrument. For this purpose it should be spread out at length on a board. Higginson published a case of some interest in this point of view.

The child fell from the mother, and the cord broke spontaneously. "The torn ends were nearly as sharp-edged and flat as if cut" (*Med. Gaz.*, vol. 48, p. 985).

This case proves that a careless or hasty examination of the ends of the cord may lead to a serious mistake.

If the cord be ruptured by natural accident the free ends are usually irregularly lacerated, and the rupture takes place either near to the placental or the navel end, more commonly within a few inches of the navel. In twenty-one of the cases observed by Klein, it was found to have been forcibly torn out of the abdomen; but it may be torn or lacerated at any part of its length, although the rupture is commonly observed near to one extremity. Among the cases of sudden delivery which occurred to Olshausen, the cord was torn through at three inches from the navel in one instance, and no bleeding followed. In two the cord was torn through its middle, and at first there was great bleeding; in three other cases it was torn close to the navel, and no bleeding had occurred. In four instances the cord was torn at five or six inches from the navel, and there was no bleeding, although it remained untied for ten minutes.

In *R.* v. *Martin* (Lewes Lent Ass., 1860), a medical witness was asked by the judge whether a rupture of the cord might not lead to fatal bleeding. The above facts show that a rupture of the cord is not necessarily fatal, even when the circumstances are unfavourable to the child by reason of the closeness of the rupture to the abdominal end.

Sometimes the mark of a previous cut may be found on the cord near one of its divided ends—the first cut with the scissors not having effectually divided it.

In one case (Lewes Lent Ass., 1852), Gardner proved, in reference to the body of a child which had been found in a privy, that the cord had been ineffectually cut in one spot previous to its complete division in another part. The cord had been also pulled out after this cut, so as to elongate the vessels; hence they projected from one part of the sheath at one cut portion, while they were retracted in the other. This accurate observation showed not only that the cord had not been ruptured by the child accidentally falling from the mother, but it served to establish the identity of the placenta, which was found concealed at a distance from the body.

The body of a child, which was found in the soil of a privy, was putrefied, but the lungs had not undergone putrefaction. Both feet were wanting and the bones of the legs were exposed, owing to the removal of the soft parts. There were no marks of murderous violence on the head, neck, or upper part of the body. About six inches of the navel-string were attached to the abdomen, and this had not been lacerated, but sharply cut through. This observation was of importance, for it suggested that the woman had not been accidentally delivered while sitting in the privy, or the cord would have been found lacerated.

The main questions were:—Did this child come into the world living, and was its death attributable to violent or accidental causes? Grains of sand and particles of coal were found upon the tongue, and in the fauces, larynx, windpipe and its ramifications, as well as in the pharynx and gullet, the mucous membrane in these parts being of a brownish-red colour. The lungs were placed at the back of the chest, the sharp edges reclining on the sides of the pericardium; they had a bluish-brown colour behind, but they were of a light red with stellated patches of redness in front. The substance of the organs was not putrefied, it was elastic when pressed, and crepitated on being cut. They contained a moderate amount of blood. Both lungs floated on water entire and divided. The stomach contained an offensive dark-coloured fluid, mixed with grains of sand, pieces of coal, and other foreign matters. The conclusions drawn were that this child was mature, that it had been born alive, the navel-string designedly cut, and its body afterwards thrown into the place where it was found, for the purpose of concealment. The inference of the child having been born alive was based on the state of the lungs and the foreign substances found in the air-passages. There had also been the power of swallowing, the same substances having been found in the stomach. For however short a time, these conditions proved that the child had lived, and had breathed after it was born. The cause of death was assigned to suffocation and the prevention of breathing.

A girl, who stated that she was not aware of her pregnancy, was suddenly delivered while sitting on a night-stool. According to her account, she fainted, and on coming to herself she found the child on the floor dead. The child had fully breathed, the umbilical cord had been cut, and there was no mark of violence on the body.

The cause of death was assigned to exposure, and the absence of those attentions required by a new-born child, as well as to congenital debility ("Ann. d'Hyg.," 1868, 2, p. 173). The woman was found guilty of causing the death of her child by imprudence, inattention, and negligence. The cutting of the cord was suspicious that her tale was untrue.

5. **The Length of the Cord.**—Should this by some accident be available it should be recorded, for though it cannot help us in cases of fractured skull from falls upon floors, etc., it may be of material importance if it be alleged that the child was strangled by it.

The length varies from some six or eight inches up to as much as five feet, but figures are here useless when facts in a given case are obtainable.

7. Evidence of Live Birth from the Skin.

The skin of a new-born child is of a bright red, and is covered with a greasy material known as vernix caseosa. This observation is in itself of no importance, except that if the child have been washed, this vernix caseosa will have disappeared and its presence or absence may be a point corroborating or negativing the tale of the incriminating person or the tale of others. It becomes a bit of circumstantial evidence which may possibly be of importance in this way.

8. Evidence of Live Birth from the Mode of Birth.

It has been suggested that when a child is born by the feet, and there are full marks of respiration in the lungs, the mode of birth will at once establish that the body must have been entirely in the world in order that the breathing should have taken place. Herapath met with an instance of this kind. It is assumed [very unjustifiably, Ed.] that the head under these circumstances is born instantaneously, and that the child cannot breathe until the head is released from the outlet. Before such a conclusion can be drawn there should be clear evidence that the child was actually born by the feet. Herapath has published a report of the case on which his opinion was requested, as well as the grounds on which he would rely, to establish the fact that a child had been born by the feet (*B. M. J.*, 1859, 1, p. 46).

If a child be born by any other than a head-presentation the chances of being born dead are very materially increased. The editor is quite at a loss to understand by what means anyone could definitely fix the presentation after a child had been born; such an idea is quite absurd.

It is, however, possible that a woman might confess or allege that a child was born feet or buttocks first (or there might, in a civil case, be the evidence of the accoucheur). In such a case as this, and only in such a case, it would have to be admitted that the child had been born alive if every piece of both lungs floated in performing the hydrostatic test. For certainly *vagitus vaginalis* would not produce this result, and if once the mouth is outside when the head comes last, certainly the rest of the head follows at once without delay.

We have now exhausted all possible sources of evidence as to "was this child born alive?" It may not be inopportune to add the following brief tabular summary in the shape of statements which, dogmatic though they be, are fully warranted by and in accord with all recent legal decisions.

Evidence Conclusive only from an Eye-witness of Birth:—

Muscular Movements. Breathing (except in known breech presentation). **Crying** (? in Scotland).

Evidence leaving Traces for Others to See and Appreciate on Autopsy, Conclusive or not, according to circumstances.

Food or Foreign Bodies in Guts or Lungs. Evidence from the Cord. Evidence from the Skin (material for cross-examination).

SUB-SECTION J.—INFANTICIDE.

This will be discussed under the following heads :—

1. Definition of the crime.
2. Attitude of the law and judges towards the crime.
3. Natural causes of death at birth.
4. Was this child born dead ?
5. Violent or criminal causes of death.

Definition of the Crime.

By infanticide we are to understand in medical jurisprudence the **murder of a new-born child**. The English law, however, does not regard child murder as a specific crime; it is treated like any other case of murder, and is tried by those rules of evidence which are admitted in cases of felonious homicide. In stating that infanticide is the term applied to the murder of a *new-born* child, it is not thereby implied that the wilful killing should take place within any particular period after birth. Provided the child be actually born, and its body entirely in the world, it matters not whether it has been destroyed within a few minutes, or several days after its birth. In the greater number of cases of infanticide, however, we find that the murder is commonly perpetrated either at the time of birth, or within a few hours afterwards.

Injuries during Birth fatal after Birth.—If injuries should be criminally inflicted on a child during birth, and the child be born alive and afterwards die from the injuries so caused, the case (infanticide, in fact) would be murder or manslaughter, according to the circumstances. The following instance is reported by Chitty (*Med. Jour.*, p. 416 ; also "Archbold," p. 345) :—

A man named Senior, an unlicensed medical practitioner, was tried in 1832 for the manslaughter of an infant, by injuries inflicted on it at its birth. The prisoner practised midwifery, and was called to attend the prosecutrix, when in labour. The evidence showed that when the head of the child presented, the prisoner, by some mismanagement, fractured, and otherwise so injured the cranium, that it died immediately *after* it was born.

It was argued, in defence, that as the child was not born (*in ventre sa mère*) at the time the wounds and injuries were inflicted, the prisoner could not be guilty of manslaughter. The judge, however, held that as the child was born *alive* and had died from the violence, the case might be one of manslaughter. This opinion was afterwards confirmed by the other judges, and the prisoner was convicted. From the decision in this case, it will be seen that the law makes the question of criminality to depend upon the period at which the injuries prove *fatal*, and not upon the time at which they are inflicted on the body of a child; and had the prisoner effectually destroyed the child before it was entirely born, he would not have been guilty of any crime. The decision appears to depend on this principle of the criminal law, that the person killed must be a reasonable creature in being, and "in the Queen's (or King's) peace"; therefore to kill a child in its mother's womb (or during birth) is no murder ("Archbold," p. 345). The child, unless entirely born alive, does not come under the description above given. According to the words of one judge, it is not an "inhabitant of this world," although it is under many circumstances *medically* but not *legally* a *living* child.

If a child is born alive, as a **result of criminal abortion**, and die, not from any violence applied to its body, but as an effect of its being immature, this will be sufficient [when proved!—Ed.] to render the party causing the abortion indictable for murder.

Attitude of the Law, Juries, and Judges, toward the Crime.

Although the law of England treats a case of infanticide as one of ordinary murder, yet there is a difference in the nature of the medical evidence required to establish the murder of a new-born child. It is well known that many children come into the world dead, and that others die from various causes either during or soon after birth. In the latter the signs of their having lived are frequently indistinct. Hence to provide against the danger of erroneous convictions, **the law assumes that every new-born child has been born dead**, until the contrary appears from the medical or other evidence. The onus of proof that a *living* child has been destroyed is thereby thrown on the prosecution, and no evidence imputing murder can be received, unless it is first made certain, by medical or other facts, that the child survived its birth, and was *legally* a living child when the alleged violence was offered to it. Hence there is a most difficult duty cast upon a medical witness on these occasions. In the greater number of cases the woman is delivered in secrecy, and no one is present to give evidence respecting the birth of the child. It is under these circumstances that medical evidence is especially required, and for medical men that the whole of the last sub-section required to be written. A medical man should be especially cautious in putting questions to a woman charged with this crime.

Body of the Child not Discovered.—In cases of child murder, medical evidence is commonly founded on an examination of the body of the child; but it must be borne in mind that a woman may be found guilty of the crime, although the body of the child is not discovered: it may have been destroyed by burning, or otherwise disposed of, and a medical witness may have only a few calcined bones to examine. In these cases of the non-production of the body, good legal evidence of the murder would, however, be demanded; and this evidence should be such as would fully establish a matter of fact before a jury. The production of the body of the child is therefore no more necessary to conviction than in any other case of murder. A woman has been tried for the murder of her child, the body of which was never discovered.

The subject of child murder has greatly attracted the attention of medical jurists by reason of the facility with which the crime may be perpetrated, and the great difficulty of bringing it home to the offender. The reports of inquests show that the deaths of infants are very numerous, and that they frequently occur under circumstances involving great suspicion. In 1891 verdicts of murder were returned in eighty-four cases of children under one month old. The strongest motive for destroying the infant appears to be shame or the disgrace of having an illegitimate child. The crime is as a rule only attempted where pregnancy has not been discovered, and where delivery is effected in concealment. If the child has been secretly destroyed, the first opportunity is taken of casting its body into the streets. When the dead body of the child is secreted on the premises, discovery generally takes place. In several instances the mothers of newly-born dead children have been brought before the coroner's court. There is usually considerable reluctance on the part of a **coroner's jury** to return a verdict of wilful murder, when the mother may be sent to take her trial at the assizes for murder. Usually, when the evidence of guilt has been so clear that coroners' juries have found verdicts of wilful murder, the prisoners have been subsequently acquitted on their trials. In the report of the Committee appointed to inquire on the best means of preventing the destruction of the lives of infants (July, 1871), it is stated that the number of infants found dead in the Metropolitan and City Police districts during the year 1870 was 276. The editor believes that the number in recent years is as great if not greater. The greater number of these infants were less than a week old.

It will be seen, from the nature of the medical proofs required, that a conviction for child murder in England, in the present state of the law, seldom takes place. Notwithstanding the frequency of the crime, juries almost invariably fall back upon the minor offence of which the accused person may be convicted, namely, that of concealment of birth (*vide* p. 65). This, in fact, in reference to the crime with which the prisoner is charged, amounts to a verdict of not proven. In some cases, however, under the direction of some of our judges, verdicts of manslaughter have been returned.

The frequent acquittals which take place on charges of child murder, in spite of strong evidence of criminality, most probably depend on the fact that there are many extenuating circumstances in a prisoner's favour which the law does not recognise. Hitherto juries have had no alternative but to convict the woman of murder, or to find her guilty of the misdemeanour of concealment of birth. Whatever doubt may be thrown on a case by the forms of law and the rules of evidence, there can be no doubt *medically* that living children are frequently destroyed at birth, and that the criminal law, from the peculiar nature and stringency of the proofs required to establish guilt, has hitherto failed to reach the perpetrators. Lankester stated that he had held inquests in sixty-nine cases of new-born children, and in every instance with which he was acquainted the persons charged had been acquitted of the crime, against evidence of the most obvious and convincing kind. The fact is, he observes, "the prosecutor, judge, and jury are all anxious to avoid a verdict which consigns to death a woman who, in nine cases out of ten, has been more sinned against than sinning." This, he remarks, will probably be the case so long as the law inflicts, or threatens to inflict, death for infant murder.

In *R.* v. *Tommey* (Warwick Lent Ass., 1854), tried before Coleridge, J., in which a medical witness declined to say positively that a child was born alive and had breathed after birth, the jury convicted the prisoner of manslaughter. Respiration had been established, but it was admitted by the witness that this might have occurred during birth or afterwards. There was a cut on the right side of the neck of the child, and a circular wound in the windpipe.

In a case tried before Brett, J. (Winchester Sum. Ass., July, 1871), a woman was indicted for the wilful murder of her newly-born child under highly suspicious circumstances. The jury returned the usual verdict of "concealment of birth."

The judge, in sentencing her, said she had escaped from the charge of murder by the indulgence of the law, and from that of manslaughter by the too indulgent verdict of the jury.

In another case tried by the same judge (*R.* v. *Maynard*, Devon Lammas Ass., 1871), the medical evidence showed that the child was newly-born and quite mature. Its head had been removed from the body, and the right leg had been cut off above the knee. On the neck, behind the shoulder, there was a bruise on the skin of a dark-blue colour, about three inches in diameter. The umbilical cord had been torn or cut at about seven inches from the body. There were slight superficial wounds on the back of the neck and other parts of the body, which was generally pale. The lungs contained air, and readily floated, even when cut into many pieces. Air escaped by pressure under water, and the pressed portions still floated. From these facts the medical witness stated that the child had been born alive, and had died from hæmorrhage. The prisoner had made a statement to the effect that the child was born alive.

The judge, in summing up the case, instead of taking the usual course, *i.e.*, of leaving the jury to decide between "murder" and "concealment of birth," impressed upon them strongly that, if not guilty of murder, they must consider whether the prisoner was not guilty of manslaughter. She was guilty of murder if, after the child was born alive, she by an act of hers caused its death, intending to kill it. She was guilty of manslaughter if, after the child was born alive, she committed an act of *culpable negligence* by which the death of the child was caused, or by which the child was not permitted to live, when it otherwise would have lived. The jury returned a verdict of manslaughter. In another case (*R.* v. *Sell*, Hereford Lent Ass., 1873), before the same judge, the prisoner, who was tried on a charge of child murder, was found guilty of manslaughter.

In another case, Willes, J., adopted the same course as Brett, J. (*R.* v. *Libbey*, Cornwall Lammas Ass., 1871). The prisoner was a married woman, charged with the murder of her illegitimate child. The body was found mutilated, and partly burnt. The head, arms, and legs had been severed. The lungs contained air, and readily floated, entire and divided. They were of a red colour, and distinctly mottled. It was concluded that the child was mature, that it had fully breathed, and from the retraction of the skin, that the cuts were made during life, or soon after death. There was no disease in the parts of the body examined to account for death. It was proved that the woman had concealed the mutilated body of the child, and had tried to get rid of it by burning. She said the burnt bones found, and some blood on a rug, were those of a fowl. The bones were those of a child, and the blood was not that of a fowl. The defence was simply, "no proof of separate existence," *i.e.*, no proof that the child was "born alive." The prisoner in this case had denied her pregnancy, had concealed her delivery, and had mutilated and partly burnt the body of the child.

The judge thus expressed his views regarding the law as it is applicable to cases of infanticide: "There was no doubt the question was, whether the case should be described as one of murder or manslaughter. Looking at the facts, as far as he could judge, the difficulty that presented itself most conspicuously was the difficulty in defining a complete birth. The state of the law on that point was extremely perplexing. If a woman could be proved to have been confined unassisted, with a view to take away the life of a child, it would be an act of murder; if, on the other hand, with no intention of killing the child, she undertook to do all without assistance that a careful and skilful person would do for her, and if she neglected this, she was guilty of manslaughter." The jury returned a verdict of manslaughter.

There could be no reasonable doubt that in this, as in numerous other cases of murder with mutilation, the child was born alive. With the evidence of full and perfect breathing, there was nothing to render it probable that this child had died from natural causes during birth; and although there was no absolute proof of a separate existence, there was everything in favour of this view. It was, from the whole of the circumstances, far more probable that this child had been destroyed and mutilated while living *after birth* than that it had been born dead, and its body mutilated and burnt merely for the sake of concealment.

The following case, *R.* v. *Lunn*, C. C. C., March, 1904, is an illustration of the leniency with which women in this position in question are treated:

> Louisa Lunn, 20, domestic servant, was indicted for the wilful murder of her illegitimate child at Wandsworth. Prisoner was employed at the address given, and it was alleged that on January 24th she secretly gave birth to a baby, strangled it, wrapped it in a cloth, and hid the body up a chimney in her bedroom. The jury found her guilty of manslaughter, with a strong recommendation to mercy, and on her promising to go for two years into a home which had offered to receive her, the judge released her on her own recognisance of 10*l.* to come up for judgment when called upon—a merciful decision which elicited spontaneous applause in court.

Dr. F. W. Lowndes has written an interesting pamphlet on this subject. He read it at a meeting of the Social Science Congress held in Liverpool in 1876, and subsequently published it for private circulation.

These illustrations of the attitude of the law and judges towards this crime, though old, still retain all their force of example, and the difficulties of steering a middle course between barbaric brutality and modern philanthropy is still felt as keenly as ever, as the two following extracts from our leading medical journals will show; they both refer to the same case, but that is immaterial for our argument:—

> At the Carmarthenshire Assizes, held on November 12th, 1903, Mr. Justice Bruce in his charge to the grand jury referred to crimes of infanticide, which he feared were becoming common, so that there was a danger of the crime being encouraged by false public sympathy. It was contrary, he said, to every principle of morals and every instinct of nature for a mother not to be careful to preserve the life of her offspring, and if infanticide came to be regarded as a light or venial crime the consequences to society would be deplorable. It was a high function of the law to protect all. The greatest were not exempt from its power, the least were not unworthy of its care, and it would abdicate one of its chief functions if it

did not exert itself to preserve the lives of innocent and helpless children. The particular case which called forth this protest of Mr. Justice Bruce was that of a farm servant who gave birth in a field to a child whose dead body was subsequently found in a pond. The evidence did not make it very clear as to whether there had been a separate existence, and there was no concealment of the facts by the girl, who declared that the child was stillborn, and she was accordingly acquitted (*Lancet*, 2, 1903, p. 1868).

At the recent Chester Assizes Mr. Justice Bruce passed sentence of death on a girl of twenty-one for the murder of her illegitimate child. The prisoner had been strongly recommended to mercy by the jury on account of her youth. In passing sentence the learned judge was only fulfilling his statutory duty. He must have known at the time that the sentence would never be carried out, and any one acquainted with his lordship can easily realise how painful it must have been for him to inflict unnecessary suffering on the unfortunate girl. An occurrence of this kind strongly supports the plea of Sir Fitzjames Stephen that in a proper case the judge should have the power of mitigating the sentence for murder. This change is urged with special reference to cases of infanticide, where the distress of mind and fear caused by childbirth is often responsible for the crime. It appears that no one has been executed for such an offence for about sixty years, yet in every case the judge has been compelled to pronounce the extreme penalty of the law; the severity of the ceremony is only modified in some slight degree by the non-assumption of the black cap. So much is left to the discretion of the bench that it would be no very violent measure of reform to allow the judge to postpone judgment until the following assizes. In the meantime all the facts might be laid before the Home Secretary, whose fiat might issue to prevent the prisoner having to undergo a trying and unnecessary ordeal. The fact that the judge had a discretion of this kind would not in any degree mitigate the consequences of the crime to one who was properly convicted of murder (*B. M. J.*, 2, 1903, p. 1420).

The medical difficulties in the way of absolutely proving "life completely external to the mother," or Mr. Justice Wright's test of live birth (*vide* p. 190), must, in the nature of things, remain for ever as great as they are at present (*vide infra*, and also under "Live Birth," pp. 191 *et seq.*), and if alteration is to come it must come from statutory law and not from *medical* jurisprudence. The editor, therefore, does not feel called upon to discuss the matter further, beyond saying that he agrees in general terms with the suggestion in the above extracts from the *B. M. J.* and *Lancet.*

Apart altogether from the medical evidence in favour of a child being born alive or dead, the latter alternative will be considered presently, there can be no question but that our present **lax method of registering stillbirths** is responsible for a good deal of infant mortality, and affords great facilities for the concealment of crime. Some slight check was put on these facilities by the Registration of Births and Deaths Act of 1874, but certificates of stillbirth are far too readily accepted even now.

Dr. Lowndes, of Liverpool, has drawn the editor's attention to the fact that only two years ago, in 1901, irregularities in the matter, of a wholesale character, were brought to light; the following note in the *Lancet* for June 6th, 1903, corroborates Dr. Lowndes' contention.

Midwives and Stillborn Children.—In the *Lancet* of April 25th (p. 1200), and of May 9th (p. 1338) the subject of certificates of stillbirth given by midwives in Manchester was mentioned in connection with a case investigated by Mr. L. J. Aitken, the then acting coroner. It was shown that at the lowest computation 500 infants must be buried in Manchester cemeteries as stillborn every year, while Mr. Aitken's calculations put the number as high as 1,500, and that, as he said, "we have not a single guarantee that every one of these has not lived." Jessie Donough, aged thirty-two years, the midwife whose proceedings had been in question, was placed in the dock before the Recorder of Manchester on May 25th, and pleaded guilty to making a false statement that a child who was born alive had been stillborn. The child had lived one and a half days. "The Recorder said he hoped the sentence he passed would be a lesson to others, and ordered the prisoner to go to prison with hard labour for twelve months." Much credit is due to Mr. Aitken for his investigation into this matter, for the proceedings of unscrupulous midwives may largely influence the rate of infant mortality.

The remedy is not altogether easy to see. Dr. Lowndes is of opinion that an alteration in the regulations of the burial of still-borns might suffice; to the editor this seems inadequate, for a few shillings would hardly stand in the way of the murder of an "undesirable"; an inquiry by some authority into every case of stillbirth seems to the editor a more likely step. The House of Commons has by a special committee reported on the subject, but so far as the editor is aware no fresh legislation has been passed affecting the matter, and the disposal of the body and the registration of stillbirth is dangerously easy (*vide* p. 191, opinion of C. M. B.).

Evidence in Infanticide.—In giving evidence at a coroner's inquest on a case of child murder, as much care should be taken by a practitioner as if he were delivering it before a judge at the assizes. It should be remembered that the depositions taken by this officer are placed at the trial in the hands of the judge, as well as of the prisoner's counsel; and should a witness deviate in his evidence at the assizes from that which he gave at the inquest, or should he attempt to amend or explain any of the statements then made, so that they might be represented as having a new bearing on the prisoner's case, he would expose himself not merely to a severe cross-examination, but probably to the censure of the court. If medical men were to reflect that in delivering their opinions before a coroner and a jury in a low tavern they are virtually delivering them before a superior court, it is certain that many unfortunate exposures would be easily avoided (*vide* Vol. I., p. 15).

The criminal law by a recent amendment (Criminal Evidence Act, 1898) now permits an accused person, if he (she) wishes, to be placed in the witness-box for examination. If there is one class of criminal cases more affected than another by this recent alteration it is certainly that of cases of infanticide. On the one hand, every little detail of her alleged actions will or may require an explanation, and upon each will she or can she be cross-examined; on the other, although she may halt in her explanations and even be somewhat contradictory, every possible allowance will be made for her (by judge, jury, prosecution and defence) in consideration of her mental condition at the time of the deed.

To the medical man who has collected his evidence in the cold unstimulating light of scientific research no such consideration will be, nor ought to be, shown; and unless he is himself very strongly indeed convinced of "separate existence," he may be certain that his evidence will at once be rejected; such conviction must rest upon very certain data to be presently considered. At the same time it is probable that if she goes into the box, many small apparently irrelevant points will arise upon which a medical jurist may be able to convict her of inconsistency, if not of actual lying. Before he can do so, however, it is first necessary that he should himself be a person of keen observation and penetration. It is here that "washed *v.* unwashed," "method of severing of cord," "tiny punctured wounds," etc., etc., have their especial importance; such apparently trivial details may easily escape observation, but unless they are noticed and reduced to writing in the medical witness's notes, it would be well for him to keep silent on them.

This forms an excellent illustration of the reasons why some cases at law fail and some succeed, the personal equation and the mental attitude of the witnesses on either side; it is often not so much what a witness says, as what he is unable to say, that influences a jury, and "I don't know," "I forgot to look," will create an impression that goes far towards an acquittal even on the face of very strong evidence which just lacks this little item of corroboration.

Counsel will decide upon the advisability or otherwise of putting their client in the box, as much upon the personality of the opposition and its witnesses as upon the tale told in confidence by the prisoner.

NATURAL CAUSES OF DEATH AT OR BEFORE BIRTH.

These will be considered in the following order :—

1. Statistics of children born dead.
2. Absence of skilled assistance.
3. Immaturity or debility.
4. Malformations incompatible with life.
5. Spasm of the larynx.
6. Diseases acquired in utero.
7. Disease of the placenta.

1. Proportion of Children Born Dead.

On any individual case of infanticide this can have but little influence as evidence; the figures themselves are, however, of some little interest.

It is well known that of children born under ordinary circumstances, a great number die from natural causes either during, or soon after birth; and in every case of child murder death will be presumed to have arisen from some cause of this kind, until the contrary appears from the evidence. This throws the onus of proof entirely on the prosecution. Many children die before performing the act of respiration; and thus a large number come into the world dead or stillborn. The proportion of *stillborn* among legitimate children, as it is derived from statistical tables extending over a series of years, and embracing not fewer than eight millions of births, varies from one in eighteen to one in twenty of all births (*Brit. and For. Med. Rev.*, No. 7, p. 235).

Stillbirths are much more frequent in first than in after pregnancies. This fact should be borne in mind when we are estimating the probability of the cause of death being natural. According to Lawrence's observations, the proportion of deaths of children born is 1 to 11 among the primiparous and 1 to 31·2 among the multiparous (*Edin. Med. Jour.*, March, 1863, p. 814). In most cases of alleged child-murder the woman is primiparous and the child is illegitimate.

There is reason to believe that the non-registration of the births of children born dead leads to many children being disposed of as still-born which have really come living into the world, but have soon died from neglect, exposure, or violence.

Should breathing be established by the protrusion of the child's head from the outlet, during the birth of the body, the chances of death from natural causes are considerably diminished. Nevertheless, as W. Hunter long ago suggested, a child may breathe and die. Thus according to this author, "If the child makes but one gasp and instantly dies, the lungs will swim in water as readily [this is inadmissible—Ed.] as if it had breathed longer and had then been strangled." In general, it would require more than one gasp to cause the lungs to swim readily in water; but waiving this point, the real question is, If the child breathed after birth, what could have caused its death? The number of gasps which a child may make, or which may be required for the lungs to swim in water, is of no moment: the point to be considered is, whether its death was due to causes of an accidental or criminal nature. So again observes Hunter: "We frequently see children born, who, from circumstances in their constitution or in the nature of the labour, are but barely alive, and after breathing a minute or two, or an hour or two, die in spite of all our attention. And why may not this misfortune happen to a woman who is brought to bed by herself?" (*op. cit.*). The substance of this remark is, that many children may die naturally after having been born alive; and in Hunter's time these cases were not perhaps sufficiently attended to. In the present day, however, the case is different; a charge of child-murder is seldom raised, except in those instances where there are the most obvious marks of severe and mortal injuries on the body of a child.

2. Absence of Skilled Assistance.

In such criminal cases as are here being considered, *i.e.*, those in which there can arise or has arisen a doubt about "born alive," the absence of skilled assistance is practically an invariable occurrence. Skilled assistance might and probably would obviate the following:—

(*a*) **Prolonged Labour.**—The actual causes of this belong to works on obstetrics (*q.v.*); a child that is slightly feeble and delicate is very likely to die from this cause. If this cause be alleged, its occurrence may be corroborated if a sanguinolent or serous tumour (called *cephalhæmatoma*, or *caput succedancum*, *vide* p. 275) is found on the head of a child, and the head itself is deformed or elongated; internally, if the vessels of the brain be in a congested state the existence of deformity in the pelvis of the woman might corroborate this view; but in primiparous women (among whom charges of child-murder chiefly lie) with well-formed pelves, delivery is frequently protracted. It is presumed that there are no marks of violence on the body of the child, excepting those which may have reasonably arisen from accident in attempts at self-delivery.

The following, taken from the *Lancet* of May 25th, 1904, is a record for a large child obstructing labour:—

Mr. Edward H. Greaves, M.R.C.S. Eng., L.R.C.P. Lond., describes in the *Guy's Hospital Gazette* of May 7th a fœtus having the following measurements: total length, 23¾ inches; circumference of neck, 10 inches; circumference round shoulders, 20 inches; circumference round chest, 16½ inches; and circumference round pelvis at crest, 15½ inches. The fœtus weighed 30 pounds 4 ounces. The patient, a cowman's wife, three years ago gave birth to a child weighing 18 pounds. "The labour was difficult but natural and not unusually long," says the narrator; "no instruments used or chloroform given and no injury to maternal parts. The child died during delivery. The mother believes herself to have been pregnant exactly eleven months."

(*b*) **Hasty Parturition.**—In cases like that reported by Wharrie, *infra*, where a woman, under the impression that she was about to have a motion, sat over a large water-jug and was delivered of a child, it is proper to make full allowance for a mistake which may be compatible with innocence. A woman is often unable to distinguish the sense of fulness, produced by the descent of a child, from the feeling which leads her to suppose that she is about to have an evacuation; and thus it is dangerous, when a labour has advanced, to allow her to yield to this feeling, for the child may be suddenly born. Two cases of this description are reported, where there could not be the slightest suspicion of criminality.

In one, a primipara, the child was actually born under these circumstances, but its life was fortunately saved; had there been no other convenience than a privy, it must have been inevitably lost. In the second, although a case of third pregnancy, the woman was equally deceived by her sensations (*Edin. Month. Jour.*, January, 1846, p. 11; see also a case in which twins were thus born, *Med. Times and Gaz.*, 1861, p. 235; also case in a primipara, *Med. Times and Gaz.*, 1858, 1, p. 148).

This alleged mistaken sensation forms a frequent and specious defence on charges of child-murder; but still a medical jurist is bound to admit, that an accident which occurs to women under circumstances without suspicion, may also occur even under suspicious circumstances without necessarily implying guilt.

The following, which is reported by Tenneson, is of some interest in this respect ("Ann. d'Hyg.," 1872, 1, p. 438):—In this case a new-born child recovered after it had remained four hours in a drain-pipe connected with a cess-pool which received the soil of privies. A girl was charged with attempted child-murder. It was proved that she had been recently delivered. She stated that she had been to the privy for a natural purpose, and was there suddenly delivered. A full-grown child was found in the large drain-pipe between the privy and the cesspool. It was alive, and was restored by the warm bath and other means. There was no mark of violence; the cord had been ruptured as by a fall, while there was nothing to show an attempt at murder. The appearances presented by the body of the child were consistent with the woman's statements. The preservation of its life was remarkable. The first part of the drain-pipe was wide enough to admit the body, which lodged at the lower part, near a bend. It was thus saved from falling into the cesspool. The drain-pipe contained air and no sewer gases—hence the child could breathe, and before removal it was heard to cry.

Devergie suggested that its life had been saved owing to the noxious gases being kept down by the drying of the surface of the soil.

In a case which occurred to Wharrie, in which the child fell from the woman while sitting over a large jug containing water, and from the state of the lungs it was evident there had been no respiration, the cord was found tied. As the child was removed from the vessel dead, the ligature must have been applied after death, and the body replaced in the jug. Drowning may be the result of accident from sudden delivery. A woman in an advanced state of pregnancy, while sitting on a chamber-vessel, was suddenly delivered. The child fell into the fluids in the vessel, and before assistance could be rendered it was dead. A woman who had already had two illegitimate children, delivered herself of a third, and alleged that it was stillborn. The body of the child was of average size. The head and face were much congested, and there was slight oozing of bloody fluid from the nostrils. The eyelids were discoloured; the lips were separated, swollen, and livid; the chest was arched. The navel-string had been cut but not tied, and there was a slight oozing of blood from it. The lungs had all the usual fœtal characters; they sank in water when cut into small pieces. There was dark fluid blood in the heart and large vessels. It came out in evidence, at the inquest, that the woman was delivered while sitting on the chamber-utensil, when the whole contents of the womb at once passed from her—the child and after-birth with the waters. A neighbour came in and placed the woman in bed, but omitted to look to the child, which was soon afterwards found dead. Parker stated in his evidence that the child had not breathed. His conclusion was that it had probably been born alive, but had died from prevention of breathing at its birth, owing to the want of proper attention.

There is no doubt that many children are thus born alive, but they do not continue to live after birth, owing to the accidental or criminal prevention of respiration. Such cases are always open to the suggestion that they arose from accident, and it is right that a woman charged with child-murder should have the full benefit of it. Two instructive cases are reported by Carson, which show that, alone and unassisted, the mother of an illegitimate child may be placed under circumstances of the greatest suspicion, although innocent of any attempt to destroy the life of her child (*Med. Times and Gaz.*, 1861, 1, p. 99; see a case in Casper's *Vierteljahrsschr.*, 1859, 2, p. 36; also in Horn's *Vierteljahrsschr.*, 1865, 1, p. 40; and "Ann. d'Hyg.," 1868, 2, p. 173).

On the 21st of June, 1904, Mr. Troutbeck held an inquest on the body of a newly-born child. In the course of the inquiry it was satisfactorily proved that the child was born during an effort to *defæcate*. The cause of death, as proved by medical evidence, was suffocation by fæces and urine, and yet every side of the hydrostatic test showed that the lungs were completely inflated. The woman was forty-two, a multipara; her youngest child was eight years old.

In connection with this subject we may ask **whether a woman can be delivered without being conscious of it.** The signs of delivery may be discovered by a practitioner; the offspring may also be found. She may admit the fact of her delivery, but allege that she was totally unconscious of it. The only kind of medico-legal case in which this plea is occasionally raised is in infanticide; and as the possibility of the occurrence may be questioned, the practitioner must be provided with a knowledge of those facts which medico-legal writers have accumulated respecting it. There is no doubt that a woman may be delivered unconsciously during profound sleep, or while labouring under coma, apoplexy, asphyxia, or syncope; or if suffering from the effects of narcotic poisons, anæsthetics, or intoxicating liquors. It is said also, that delivery has taken place spontaneously while a woman was in the act of dying. This, however, has no bearing on the present question. It is in those cases where a woman, after her recovery, pleads unconsciousness of delivery, that medical practitioners are chiefly consulted. Besides the cases enumerated, hysteria, when accompanied with loss of sense and motion, has been mentioned as a state in which parturition is liable to occur unconsciously. We need not be surprised at delivery taking place under these circumstances, when we consider that the contractile power of the uterus is altogether independent of volition; but, unless the morbid states already mentioned are accompanied by the most profound lethargy and entire loss of sensation, it can rarely happen that the contractions of this organ, in its efforts to expel the child, should not at once rouse a woman into consciousness. We ought particularly to expect this in primiparæ, *i.e.*, in those who have never before borne children. At the same time it must be remembered that parturition in some women, especially when the pelvis is wide and the child small, may take place with such rapidity and ease as scarcely to be accompanied with pain.

It has been observed that, when a woman has frequently borne children, delivery sometimes takes place without effort, and without any consciousness on her part. On other occasions a woman may lie in a state of torpor or stupor, or suffer from **puerperal convulsions**, and have no recollection of her delivery. The following case is possible:—

A woman may be delivered while under the influence of puerperal convulsions, which might have attacked her before labour set in; and after delivery, but before complete recovery, she might become maniacal, during which interval she might have killed or injured her child; or the child might have been born dead, or an accidental injury might have occurred to it. She would with truth assert her entire ignorance of it. Her statement would be verified by a bitten tongue, and a congested conjunctiva or face.

Should albumen be found in the urine, this fact would be still more confirmative. Of course convulsions might occur without these results. The statement might be disproved by finding that her actions had shown care and design in other circumstances, at the time she said she was unconscious. King has described the case of a woman, æt. 36, the mother of nine children.

She received his assistance in her tenth labour: when summoned she was lying calmly and placidly in bed, and was perfectly insensible. He found that the child had been expelled with the placenta. The woman did not recover her sensibility for ten or twelve hours, and then stated that she had no recollection of the birth of the child, or of any circumstances connected with that event; she suffered no pain nor uneasiness. Another case is mentioned by him, in which sensation appeared to be entirely paralysed during labour (*Med. Times*, May 15th, 1847, p. 234).

It is beyond a doubt that profound lethargy occasionally makes its appearance about the time of delivery.

A woman remained in a state of sleep for three days, and was delivered while in this unconscious condition: on awakening, she had no recollection of having suffered any pain during delivery ("Ann. d'Hyg.," 1845, 1, 216; *Med. Gaz.*, vol. 36, p. 40). Montgomery relates the case of a lady, the mother of several children, who, on one occasion, was unconsciously delivered during sleep ("Cyc. Pr. Med."; see also case in *Brit. and For. Med. Rev.*, No. 9, p. 255). Palfrey describes a case in which labour commenced and progressed in a woman to the second stage during sleep (*Lancet*, 1864, 1, p. 36).

The results obtained by the use of anæsthetics show that the expulsive efforts of the uterus are often as energetic in the unconscious as in the conscious state. It may appear extraordinary, however, that a primiparous woman, unless rendered unconscious by narcotic substances, should be delivered without suffering pain: nevertheless, a case of this kind is recorded.

The woman's age was twenty-one; she had been in labour about six hours; she complained of no pain, and the child was born without effort or consciousness. The child was healthy but small, weighing rather more than four pounds (*Cormack's Jour.*, January, 1846, p. 12). A healthy young woman, married about ten months, and expecting her confinement, was seized with some pains in the lumbar region. On examination, the os uteri was found to be three-fourths dilated. As the pains showed no signs of returning, her doctor left her. He was suddenly called to her in about six hours, and then found that the head of the child had been wholly expelled during the profound sleep of the mother. In a moment the body was delivered, and the placenta followed it, the uterus contracting with scarcely any pain. The patient said she had dreamed something was the matter with her, and awoke with a fright, probably at the instant that the head was expelled (*Amer Jour. Med. Sc.*, January, 1868, p. 279). Some remarks on this unconscious state of women during delivery, by Seydel, will be found in Horn's *Vierteljahrsschr.*, 1868, 2, 317, under the head of *Eclampsia parturientium.*

The other case, commoner even than actual unconsciousness, in which a woman may assert that delivery took place without her knowledge, viz., during relief of the bowels or in response to a mistaken idea of wishing to relieve them, we have dealt with above.

Notwithstanding these cases, it is in the highest degree improbable that any primiparous woman should be delivered during *ordinary sleep* without being roused and brought to a sense of her condition; perhaps she would be by a desire to go to stool: but before we make the admission in regard to any particular instance, we ought to have a statement of all the facts from the woman herself. It has been properly observed that, *after* an accident of this kind, a woman cannot be ignorant of her own delivery [unless she faints, a by no means uncommon occurrence—Ed.] Women who have raised this plea in cases of child-murder have often been known to maintain that they were **unconscious of their pregnancy,** and thus have attempted to excuse themselves for not having prepared the articles necessary for childbirth. It is possible that a woman, especially one who is pregnant for the first time, may not be aware of her pregnancy in the early stage, but it is rare for one to advance to the full term without being conscious of it. Women who have borne children have sometimes consulted medical men, and, although nearly at full term, they have not been conscious of their state. In the majority of instances, it may be presumed that a woman thus situated must have had some reason to *suspect* her condition; and if only a suspicion existed in the mind of one who did not contemplate the destruction of her offspring, there assuredly would be many circumstances forthcoming which would at once establish her innocence. If this remark applies to married women, it applies with still greater force to those who are unmarried, since the fact of illicit connection and the fear of its consequences must render them peculiarly alive to all those changes which, by common repute, take place in the female system during pregnancy.

(*c*) **Suffocation in the Clothes, Urine, Fæces, Blood, Liquor amnii, etc.**—An infant is easily destroyed by suffocation. If the mouth and nostrils are kept covered for a few minutes, by the face being closely wrapped in clothes, asphyxia may come on without this being indicated by convulsions or any other marked symptoms (Vol. I., "Asphyxia"). A suspicion of murder may arise in such cases; but the absence of marks of violence, with an explanation of the circumstances, will rarely allow the case to be carried beyond an inquest.

The simple pressure of the clothes or absence of fresh air is not likely to leave any marked traces externally, but internally there may be evidence of asphyxia (*vide* Vol. I.).

If the other substances mentioned have caused suffocation in a living child, they will be found in nose, mouth, lungs, or stomach (*vide* Vol. I., pp. 662 *et seq.*); their presence is suggestive of live birth, and conclusive of life during birth, with efforts at respiration; their absence by no means negatives this form of death. Duncan states that obstruction of the air-passages by mucus and other matters is a frequent cause of death in new-born children. Among twenty-seven children dying in labour, or shortly after birth, eleven were destroyed by obstruction of the air-passages with such matters. Eight were born dead, and of those which were alive at birth, none survived the first day. In ten of the cases the obstruction was produced by a greenish or greenish-brown slimy mass (meconium and mucus) filling the larynx and windpipe. In two of the cases, in which the child died during delivery, air was found in the lungs, and in only one of these had the air been derived from the act of respiration during birth (*Edin. Month. Med. Jour.*, April, 1863, p. 924: also *Med. Times and Gaz.* 1861, 2, p. 116).

Braxton Hicks has shown that a child may be born living without breathing, simply owing to the **spasm of the larynx** and retraction of the tongue. He has on several occasions seen a new-born infant make attempts at inspiration, but owing to the cause above-mentioned these efforts were ineffectual.

In one case to which he especially refers, he lifted up the epiglottis by pressing upwards and forwards the root of the tongue: the air then entered easily, and the child was saved (Guy's Hosp. Rep., 1866, p. 476).

But many children must be born under similar conditions when no assistance is at hand. Cases of this kind, however, rarely give rise to charges of child-murder, as no air is found in the lungs, and there are no marks of violence on the body. A child might be killed during delivery by pressure applied to the chest; this might be such as not to produce any indications of violence. If the child had not breathed, there would be nothing to show the mode of death; but if air had entered the lungs, then the usual appearances would be found in these organs (p. 193 *ante*). In dealing with a case of this kind, it should be remembered that a child with its head born, but detained in the outlet by the size of its shoulders, might die from pressure exerted on the chest by the vagina. It might have breathed, but be born dead with the marks of suffocation about it. There is another accidental cause of the death of a new-born child during delivery, The **membranes or caul** may be carried forward over the head and face, and the act of breathing thus mechanically prevented. If no assistance is at hand, the child, although born living, will die soon after birth in consequence of the prevention of respiration. If, when the dead body is found, the membranes are no longer there, the cause of the prevention of respiration would not be apparent. The child, although born living, would probably be pronounced to have been born dead (see case, *Med. Times and Gaz.*, 1863, 1, p. 126). The delivery of a child with a mask or caul around its head is not an unfrequent occurrence.

In 1862 a mature and healthy child so born was allowed to perish by those who had access to it. The caul was simply not removed, so that breathing could not be set up. The lungs contained no air. There was congestion of the brain and lividity of the body, but no mark of violence. There was some evidence that the child had been born living, and that the cause of death was the prevention of respiration by omission to do that which was necessary.

In the *B. M. J.*, 1, 1910, p. 1289, a case is reported by Dr. Pendred in which a child was left in its complete membranes for 45 minutes and yet survived with artificial respiration.

As the medical evidence showed that the child had not breathed, the coroner held that it had never had any (legal) existence, and that there was no ground for any further investigation. It may be added that a primiparous female may be ignorant of the necessity of removing the child; and thus it may be suffocated without her having been intentionally accessory to its death. In such cases, however, there should be no marks of violence on the body, or, if present, they should be of such a nature and in such a situation as to be readily explicable on the supposition of an accidental origin (see case, Horn's *Vierteljahrsschr.*, 1864, 2, p. 123.)

(*d*) **Prolapse of the Cord.**—This is hardly likely to be alleged as the cause of death; it is not probable that there will be any evidence of its having occurred, but as it may have caused vagitus uterinus or vaginalis, it is possible that by finding vernix caseosa or liquor amnii in the mouth and lungs its occurrence may be suggested; in breech presentations the cord is very liable indeed to be compressed in the absence of skilled assistance.

(*e*) **Strangulation by the Cord.**—Very frequently the cord is twisted firmly round the neck, and it has seemed to the editor a sufficient cause for death in many instances, even with skilled assistance. The cord is so soft that usually no abrasion of the skin is caused by it, though the actual indentation of the tissues may be apparent enough: still, even these may be absent, and if the accident is alleged it cannot be proved that it did not occur, though evidences of other violence may show that it was an unnecessary accessory to death (*vide post*, p. 271 *et seq.*).

It is probable that a more careful inspection of the body in these cases would show that, as in fœtal animals, so in the human fœtus, pressure on the navel-string during parturition produces asphyxia in the fœtus, with the result that Tardieu's ecchymotic spots are developed on the surface of the pleura, the thymus gland, the heart and pericardium, etc. Dr. Stevenson, in 1882, examined the lungs of a stillborn child which died during parturition, the navel-string being prolapsed, in which these ecchymotic spots were exquisitely developed.

There is a singular cause of death in reference to the umbilical cord which must here be noticed. It is well known to accoucheurs that knots are sometimes formed in the cord. The body of the child in its movements *in utero* may occasionally pass through a loop of the cord, forming a knot, which may be tightened by its further movements, or remain loose until delivery. Lee observes that the fœtus thereby unconsciously commits suicide by compressing the vessels and arresting all circulation between it and the placenta. The fœtus may perish before birth, or it may die from the compression naturally produced by a protracted labour. Such an accident may occur by the fœtus passing through a loop while its head is passing through the mouth of the uterus, so as to form a knot at the very moment when the body passes into the world. Whether the child had breathed effectively or not, it might die by fatal compression of the cord before its birth was completed (see a paper on this subject by Read, with a variety of illustrations of umbilical knots, in the *Amer. Jour. Med. Sc.*, October, 1861, p. 81). The cause of death would always be apparent if the cord could be obtained for examination. The cord may be the means of producing other marks of injury on the body of the fœtus *in utero* which, however, could hardly be mistaken for the effects of violence in the extra-uterine state. The amputation of the limbs of the fœtus has been produced by a tightly constricted cord. Montgomery has directed attention to this subject. Beatty describes the case of a fœtus in the fourth month, round the left arm of which there was a deep groove approximating to a complete separation of the limb. A coil of the cord was in this groove at the time of expulsion, and if continued it would have completed the amputation of the arm (*Dub. Hosp. Gaz.*, January 1st, 1846).

Intra-uterine amputations are now commonly attributed to such accidents.

(*f*) **Hæmorrhage from the Cord.**—In precipitate labour the cord may be torn, and it is usually assumed that such tearing will prevent hæmorrhage, but as to the strict and universal truth of such assumption the evidence seems to the editor to be inconclusive. It may, however, be severed in other ways, either by accident or deliberately by the mother, and she may be unable to tie it herself; it is thus possible for a fatal bleeding to take place if skilled assistance be not at hand, and several such are recorded.

Bleeding from the cord has been observed to take place at various periods after birth, and has led to the death of the child. Death from bleeding may be commonly recognised by the blanched appearance of the body and a want of blood in the internal organs. There are several cases on record in which the cord was ruptured close to the abdomen without causing the death of the child. It was formerly a debated question whether, in the event of the umbilical cord being left untied after cutting or laceration, such a degree of hæmorrhage could in any instance occur as would prove fatal to a child. The cases above referred to render it unnecessary to discuss this question. Bleeding is more likely to prove fatal when the cord is divided by a sharp instrument than when it is lacerated (*vide* Vol. I., p. 409); and its dangerous effects on a child are likely to be great in proportion as the division is made near to the navel. It has been described as a case of infanticide by *omission*, when a self-delivered woman neglects to apply a ligature to the cord under these circumstances; because, it is said, she ought to know the necessity for this in order to prevent the child dying from hæmorrhage. Such a view assumes not only malice against the accused, but that in the midst of her distress and pain she must necessarily possess the knowledge and bodily capacity of an accoucheur—a doctrine wholly repugnant to the common feelings of humanity. This question was, however, raised in the case of *R.* v. *Dash*, August, 1842. There was no doubt in this instance that the child had breathed, and that its death had been caused by bleeding from the lacerated umbilical cord. The medical witness admitted that the cord might have been torn through by the mere weight of the child during labour ; and the jury acquitted the prisoner, on the ground that she might have been ignorant of the necessity, or not have had the power to tie it. The cord, especially when short, may become accidentally ruptured during delivery.

A child was born alive after a strong pain ; and on examination it was found that the cord was torn through at about an inch from the abdomen. On measuring the cord it was found to be only four inches and a quarter in length (*Med. Times*, July 24th, 1847, p. 433). In another case there was no rupture but great pain caused to the woman during delivery ; and the cord was only five inches long (*Lancet*, July 11th, 1846).

Bleeding from the vessels of the navel-string may prove fatal several days after birth, even when a child has been properly attended to, and the navel-string has separated by the natural process. Willing has reported a case of this kind, in which, in spite of every application, the child died from loss of blood six days after the cord had separated (*Med. Times and Gaz.*, 1854, 1, p. 287). The impossibility of arresting the bleeding in this case appeared to depend upon a great deficiency of fibrin in the blood, and a consequent want of tendency to coagulation. [The child was probably the subject of hæmophilia.—Ed.]

(*g*) **The Effects of Abnormal Presentations, Placenta Prævia or Premature Separation of the Placenta.**—This subject cannot be discussed here, suffice it to say that without skilled assistance this condition of affairs is very likely indeed to prove fatal both to mother and child.

3. Immaturity or Debility.

A child may be born either prematurely or at the full period, and not survive its birth, owing to a natural feebleness of system. This is very commonly observed among immature children. Such children may continue in existence for several hours, breathing freely, and may then die from mere weakness. These cases may be recognised by the immature condition of the body and the general want of development. There will also be the negative evidence of no other possible cause for death. In the *B. M. J.* for December 14th, 1901, the reader will find an extraordinary case of death in a mature child, apparently from sheer inability to live, but no autopsy is recorded.

4. Malformations Incompatible with Life.

These are very numerous, and must for our present purpose be divided into those which are incompatible with life for more than a few minutes or hours, and those which, unless removed by surgical aid, will only prove fatal in a few days or even longer.

To the former class belong **acephalous and anencephalous monsters, extroversion of the heart,** and certain other abnormalities of the main blood-vessels; to the latter belong **imperforate anus, constriction of œsophagus or duodenum or obliteration of part of the alimentary canal.** The cases of both classes are too numerous to need any special references, they may be found by dozens in works on children's diseases (Ashby and Wright, or Keating's Encyclopædia; but there can be no difficulty in determining whether they are such as to account for death. Persons are not allowed to destroy monstrous births, and the presence of marks of violence in such cases should be regarded with suspicion. It is the more necessary to make this statement, as there is an idea among the vulgar that it is not illegal to destroy a monstrous birth.

A lady was delivered of a most hideous dicephalous (two-headed) monster. At the earnest solicitation of the friends, the nurse destroyed it. The question was—Was this woman guilty of child-murder?

The only case in reference to this point which is recorded by medico-legal writers, is that of two women who were tried at the York Assizes in 1812, for drowning a child which was born with some malformation of the head, in consequence of which it was likely that it could not survive many hours. It did not appear that there had been any concealment on the part of the prisoners, who were not aware of the illegality of the act (Paris and Fonblanque, "Med. Jurispr.," Vol. I., p. 228). The fact that the offspring is not likely to live more than a few hours does not justify the act of one who prematurely destroys it.

5. Spasm of the Larynx.

Strong and healthy children may die from non-inflation of the lungs. They are born with uterine life, and on coming into the world make atempts at inspiration, but, as Braxton Hicks has pointed out, owing to spasm of the larynx and retraction of the tongue, the air is unable to enter—the child dies, and on inspection, no air being found in the lungs, the child is wrongly pronounced to have been born dead (Guy's Hosp. Rep., 1866, p. 476). A careful inspection of the fauces may show the presence of mucus or meconium, or a condition of the epiglottis, which may account for non-respiration. Hicks has on more than one occasion seen the new-born child make these inspiratory efforts, and by lifting the epiglottis has given free passage to the air, and the child has been saved.

6. Diseases Acquired in Utero.

The discovery of any of the fœtal organs merely in a morbid condition amounts to nothing unless the disease has advanced to a degree which would be sufficient to account for the child's death. There are, doubtless, many obscure affections, particularly of the brain, which are liable to destroy the life of a child without leaving any well-marked changes in the dead body. According to Burgess, apoplexy and asphyxia are the usual causes of death among new-born children, the latter the more common (*Med. Gaz.*, vol. 26, p. 482; Henke's *Zeitschr. der S.A.*, 1843, p. 67). Probably diseases of the lungs are of the greatest importance in a medico-legal point of view; because, by directly affecting the organs of respiration, they render it impossible for a child to live, or to survive its birth for a long period. The diseases in the fœtal state are principally hepatisation, tubercle, and syphilis of the lungs—the existence of any of which it is not difficult to discover. They render the structure of the lungs heavier than water, and thus prevent them from acquiring that buoyancy which in a healthy state they are known to possess. It is not common to find the lungs diseased throughout—a portion may be sufficiently healthy to allow of a partial performance of respiration.

In addition to diseases thus leaving traces in the internal organs, it must not be forgotten that any of the acute specific fevers in the mother will almost certainly lead to the expulsion of the contents of the uterus. If the mother's attack be at all severe, the child is nearly sure to be born dead from a toxæmia of its blood, or sometimes even from an actual and definite invasion of the child by the microbes of the disease with definite skin eruption. Small-pox and scarlet fever rashes have been thus definitely seen on a new-born child.

In the *Lancet*, 1, 1904, p. 575, is an account of a case of gangrene of the foot in a newly born baby without any suspicion of malpractice, reported by D. Cotes-Preedy.

7. Disease of the Placenta.

Usually syphilitic in origin or due to accidental separations of parts of it. Such can only of course be detected if the placenta is available for examination, or its site owing to the death of the mother.

WAS THIS CHILD BORN DEAD?

The answer to this question will depend upon four factors, viz.:—

1. The period of development to which it has reached.
2. The presence of ante-partum rigor mortis.
3. The presence of ante-partum decomposition.
4. The absence of evidence of live birth.

Either of the first three of which may give very positive evidence, the fourth can only be of doubtful value.

1. Stage of Maturity.

One of the first questions which a witness has to consider in a case of alleged child murder is that which relates to the age or probable degree of maturity to which the deceased child may have attained in utero. The reason for making this inquiry is, that the chances of natural death, at or before birth, in all new-born children are great in proportion to their immaturity: and that, supposing them to have survived birth, the signs of their having breathed are commonly obscure. It is found that the greater number of children who are the subjects of these investigations have reached the eighth or ninth month of gestation; yet charges of murder might be extended to the wilful destruction of children at the seventh month or under, provided the evidence of life after birth is clear and satisfactory.

The English law does not act on the principle that a child, in order to become the subject of a charge of murder, should be born *viable*, *i.e.*, with a capacity to live. It is observed by Chitty, although no authority is quoted for the statement, that "the object of the law is to prevent injuries to infants having a capacity to maintain a separate existence;" and he further suggests that such a capacity should be proved in order to complete the offence of infanticide ("Med. Jur.," Vol. I., p. 411). This argument, carried to its full extent, would render it no offence to put to death all persons afflicted with any mortal disease. We have been unable to find, in the numerous reported trials for infanticide, any ground for this statement. The capacity of a child for continuing to live has never been put as a medical question in a case of alleged child-murder. Children may be born alive at the sixth or seventh month; but because they are much less likely to survive than those at the eighth or ninth month, this is not a ground of exculpation for any person who may wilfully destroy them. The real question, as we shall presently see, does not refer to the period of gestation at which a child may be born, but to the fact of its being *living* and *entirely born* when the murderous violence is offered to it. The meaning of the term *viability* as applied to new-born children, has been elsewhere considered ("Shortened Gestation" and "Live Birth," pp. 47 and 190 *et. seq.*). Tardieu, in treating of infanticide, remarks that by viability the medical jurist must understand not life, but a fitness to continue life. Infanticide requires only that the child should be living. The crime implies the destruction of a new-born child, "born living," whatever may be its age, state of development, shape, strength, or capacity to live. Child-murder is therefore entirely independent of the question of viability, and yet it often happens on these occasions that a medical witness is asked—Was the child viable? But this question is put in order to show how far the strength of the child would enable it to resist the violence inflicted on it.

Although the doctrine of viability is not recognised in English jurisprudence, yet in a case which occurred in 1836, a coroner refused to hold an inquest on the body of a child because it had not reached an age (seven months), at which children are commonly born alive. In this case there was probably no harm done; but when we consider—1st, the great difficulty of determining the exact age of a child from the characters found on its body; and 2nd, that many children born under the seventh month have not only been born alive, but have lived to an adult age, the adoption of a principle of this kind would be likely to give rise to dangerous abuses. It is impossible to admit that children may be destroyed with impunity because they happen to be born under the seventh month, or that a child should be assumed to have been born dead, and an inquiry into the cause of death dispensed with, unless it can be medically established that it has passed the seventh month of gestation.

According to one medico-legal authority, if it can be shown that the child which is the subject of investigation has not attained this age (the seventh month), no charge of infanticide *can* or *ought* to be entertained. Are we to understand by this that children proved to have been born living before the seventh month may be wilfully destroyed, and the law take no cognisance of the matter? This principle is not recognised by the law of England. In the case of *R. v. West* (Nottingham Lent Ass., 1848), a midwife was tried on the charge of causing the death of a child under the seventh month of uterine life (in the perpetration of abortion), not by direct violence applied to its body, but merely by leading to its premature birth. This case proves, therefore, that a charge of child-murder may be fairly entertained with respect to children *under* the seventh month. The woman in question in this instance was alleged to have been between the *fifth and sixth* months of pregnancy. The proof of this fact did not, however, prevent an indictment for murder, and a full investigation of the case. We also learn from it, contrary to the suggestion of Chitty (*supra*), that the *viability* of a child is not by the English law required to be proved on an indictment for child-murder. The child was certainly from mere immaturity incapable of maintaining a separate existence, and it was therefore *not viable;* but the judge who tried the case, in answer to an objection taken by prisoner's counsel, said that if the child was proved to have died under the circumstances alleged for the prosecution, it would still be murder. In reference to children born at the fourth or fifth month of gestation, a charge of concealment of birth may arise so long as the offspring has human form. Under these circumstances it is not necessary to prove that it was born living. At the same time, as such births at the fourth and fifth months are always the results of abortion either from natural or criminal causes, the charge is generally merged in the criminal offence of procuring abortion. Here, again, it is not required to prove by medical evidence that the aborted fœtus was living when expelled from the womb (p. 45 *ante*). In nearly all cases of child-murder, it will be found that the child has passed the seventh month of utero-gestation. The conclusion of this argument is this, that as there is no case on record (*vide* p. 47) of a child born before the 150th day of conception showing any signs of life, it follows that if a fœtus at or under this age be found, it must have been born dead, and no question of infanticide can arise.

2. Ante-partum Rigor Mortis.

This has been recorded by several observers, and has even been used as a test of degree of maturity. The following taken from the *Lancet*, 2, 1895, p. 1020, reported by Dr. Jones, of Leigh, Lancs., seems to show that it is not so very infrequent, but is probably overlooked. Its occurrence is, of course, mathematical demonstration of "born dead."

> Some few years ago I sent an account to a contemporary of a case in which rigor mortis in the fœtus in utero was the cause of difficult labour. During the last two years I have had three other cases, so that an event which I looked upon as rare must not infrequently occur; but it appears to have passed unnoticed by the generality of practitioners, as everyone to whom I have spoken about the matter has confessed that he had never even heard of, much less seen, such a case,

and the text-books do not mention it. The following notes of my last case are, I think, worth placing upon record.

On September 6th I was called in to a primipara, aged thirty-seven, by the midwife in attendance, as, though the os was fully dilated, no advance of the head had taken place for several hours. On applying forceps considerable resistance was experienced, and what I expected to find an easy forceps case proved to be quite the reverse. Progress was slow until I secured extension, when the head came down well; but further difficulty was experienced in extracting the body, which gave the impression of being much too large for the maternal passages. The fœtus, however, proved to be not large, but rather under the average. The difficulty had arisen at the various stages: first, the normal flexion had not taken place, and at a later stage the stiffness of the neck had prevented extension, and the lateral flexion of the body had been interfered with owing to the same cause. Rigor mortis was well developed all over the body, the arms and legs being stiff and in the flexed position. On balancing the child's body on one hand its back kept almost straight and the legs in the same flexed position, the heels not dropping below the nates. Owing to the forcible flexion of the neck the head moved upon the trunk like a hinge joint. At the moment of applying pressure with the forceps there was a crunching noise quite audible, sounding as if one were breaking a bone.

For further references, *vide* Vol. I., p. 257.

3. Signs of Putrefaction in Utero.

The phenomena of putrefaction in air have been elsewhere described (Vol. I., pp. 286 *et seq.*); but the changes which ensue when a child dies and is retained within the uterus, may be briefly adverted to, because they may sometimes form a subject for judicial inquiry. According to Devergie, when a child dies in utero, putrefaction takes place as rapidly as in the open air ("Méd. Lég.," 1, 526); but this is doubtful.

In an advanced state of *uterine putrefaction* (intra-uterine maceration), the body of the child is so flaccid that when placed on a table it becomes almost flattened by the mere gravitation of its parts. The skin is of a reddish-brown colour—not green, as in a putrefied body exposed to air. The cuticle covering the feet and hands is white, and sometimes raised in blisters; the cellular membrane is filled with a reddish-coloured serum; the bones are movable, and readily detached from the soft parts. In the opinion of Devergie, the principal difference between uterine and atmospheric putrefaction, in the body of a new-born child, is seen in the colour assumed by the skin: but it must be remembered that, should the child remain exposed to the air after its expulsion, the skin may acquire the colour observed in cases of atmospheric putrefaction. There is also an easily recognisable (once it has been experienced) smell about intra-uterine decomposition, quite peculiar and pathognomonic; it is rather a sickly than pungent smell of decomposition, but it can hardly be described in words. The changes which have just been described are such as we may expect to find when a child has been retained in the womb eight or ten days after its death. When it has remained for some weeks in the uterine cavity, the body has occasionally been found in an adipocerous state, or even encrusted with phosphate of calcium. If in any case we are able to state distinctly that the body of a child has undergone uterine and not atmospheric putrefaction, it is clear that it could not have come into the world alive, and no question of murder could arise. Under ordinary putrefaction in air, a child may have been really brought into the world living, and the process may have destroyed every proof of that fact.

Let us suppose that a child died in utero twenty-four hours before it was born; if it be soon afterwards examined, there will be no marks of putrefaction about it, unless the membranes have been ruptured, and the appearances will closely resemble those met with in the body of a child that has been born alive, and died without breathing; or of one that may have died in the act of birth. It will be impossible to say, in such a case, whether the child came into the world living or dead. Sentex states that the dead fœtus retained in utero, with the membranes unruptured, undergoes one of three changes—maceration, putrefaction, or mummification. The first is the most common condition, but the changes differ from those which take place in the body when exposed to air. Putrefaction, in its common signification, is rarely met with. Sentex has given a summary of the appearances as met with in the dead fœtus from the second day to the second week ("Ann. d'Hyg.," 1869, pp. 1, 487). Braxton Hicks found that rapid decomposition took place when the child died some time before the commencement of labour. In one case he had known putridity to have been established in twelve hours. He met with three instances in which there was proof that the child was alive within twenty-four hours of its birth, and yet its body was born more or less putrid (decomposed); but in these instances of rapid putrefaction, the membranes had been ruptured for some time (Guy's Hosp. Rep., 1866, p. 477). This rupture is, no doubt, one of the conditions which materially influence the degree of decomposition which the dead body of a fœtus undergoes in the womb, and may account for the discrepant statements made by some writers on this subject. A medical man cannot rely upon the presence of offensive discharges before birth as absolute evidence of the death of the fœtus. In two instances Hicks met with well-marked putridity of the discharges before the birth of the child, yet in one of these the child was born alive and strong. In the other there was evidence of life in the child (*loc. cit.*).

It is needless to do more than state that no question of live birth can arise when separate bones, a mummified fœtus or a lithopædion, are removed from a woman.

Once a child is born and exposed to the air with its microbes, the changes of putrefaction elsewhere described (*vide* Vol. I., pp. 286 *et seq.*) go on in its body as in those of an adult; it may be repeated here that a child cools more rapidly than an adult, and putrefies, *cæteris paribus*, also more rapidly, and inasmuch as new-born babies are frequently thrown into water, cesspools, etc., attention should be drawn to those agencies, as they effect decomposition.

Read states that he met with a case of desquamation of the cuticle in a living new-born child. The woman was prematurely confined, in consequence of an accident. The hands and feet of the child when born were denuded of cuticle, which hung from them in shreds. The child was apparently at the eighth month, and lived twenty-four hours (*Amer. Jour. Med. Sc.*, October, 1861, p. 583) [probably a case of intra-uterine pemphigus—Ed.]. This, at any rate, shows that desquamation of the cuticle in a new-born child is not always a sign that it has been dead for a considerable length of time. All the other signs indicative of putrefaction would, in such a case, be absent, and from this fact a medical jurist would be able to draw a clear distinction.

In certain cases, where the body of a child has been long buried in the earth, the bones only may be producible. The question that would be likely to arise here would be:—Whether the bones were those of a new-born child or of one that had survived its birth for some weeks or months. There will be no difficulty in coming to a conclusion on the question (see Vol. I., p. 214), and the answer may at once put an end to the charge of infanticide. Behm records a case of this kind. He concluded, from his examination, that the child, whose bones were submitted to him, had lived for six or eight months after birth, and that they had been buried for fifty years or longer (Horn's *Vierteljahrsschr.*, 1868, 1, p. 55.

4. NEGATIVE EVIDENCE FROM ABSENCE OF BREATHING, ETC.

It was formerly supposed that if the lungs contained no air, the child could not have breathed, and it must have been born dead. But this view is not correct: *vide* "Live Birth," *supra.*

The restoration of many children apparently born dead is a clear proof that many are born living who might be pronounced dead, simply because breathing and life have been considered synonymous terms.

That our law-authorities will admit evidence of life in a child before the establishment of respiration is clear from the decision in *R.* v. *Brain*, in which the judge said, that a child might be born alive, and not breathe for some time after its birth (Archbold, "Crim. Plead.," 367), as also from the charge of Coltman, J., in the case of *R.* v. *Sellis*) Norfolk Spr. Circ., 1837). In this instance it was alleged that the prisoner had murdered her child by cutting off its head. The judge directed the jury, that if the child was *alive* at the time of the act, it was not necessary, in order to constitute murder, that it should have breathed. In fact, breathing is regarded as only *one* proof of life; and the law will, therefore, receive any other kind of evidence which may satisfactorily show that a child has lived, and make up for the proof commonly derived from the state of the lungs. It will be first necessary for a medical practitioner to prove that the child under examination has recently died, or, in other words, that there are good grounds for believing it to have been *recently living*. Hence, if the body be highly putrefied, either from the child having died in the womb some time before birth, or from its having been born and its body not discovered until putrefaction had far advanced both internally and externally, the case is usually hopeless. The medical witness will in general be compelled to abandon the investigation, because the body can furnish no evidence whatever of life after birth. The examination of the organs of the chest would throw no light on the case, if the lungs are in their fœtal condition.

We cannot here repeat the arguments used in finding evidence of live birth, but we may insert the conclusions which Dr. Taylor drew from the various tests, for they show well the very small value to be attached to the negative evidence we are now considering.

The slightest consideration will show that the various signs of live birth described on pp. 180 *et seq.* are weak, and of purely accidental occurrence. If a child is destroyed either during birth, or within a few minutes afterwards, there will be no medical evidence to indicate the period at which its destruction took place; the external and internal appearances presented by the body would be the same in the two cases. It is most probable that in the greater number of instances of child-murder, a child is actually destroyed either during birth, or more probably immediately afterwards; and, therefore, the characters above described can rarely be available in practice. If any exception be made, it is with respect to the nature, situation, and extent of marks of violence; but the presence of these depends on mere accident. Hence, then, we come to the conclusion, that although medical evidence can generally show, from the state of the lungs, that a child has breathed, it can rarely be in a condition to prove, in a case of infanticide, that its life certainly continued after its birth. We could only venture upon this inference when the signs of breathing were full and complete, or when some article of food was found in the stomach. The inference which we may draw from these observations is, that if positive proof of *entire live birth* be in all cases rigorously demanded of medical witnesses on trials for child-murder, it is scarcely possible that any conviction for the crime should take place, except where a confession was made by the accused, or a murder was actually perpetrated before eye-witnesses.

On this point Dr. Taylor collected the following conclusions from the discussion on pp. 180 *et seq.* :—

1. That a child may be born alive and be criminally destroyed before it has breathed.

2. That there are no certain medical signs by which a child which has not breathed can be proved to have been living when it was maltreated.

3. That a new-born child may be destroyed by the prevention of respiration during delivery.

4. That a child may breathe before, during, or after birth, but the hydrostatic test will not enable us to say, in the greater number of cases, at which of these periods the act of respiration was performed.

5. That the proof of respiration shows that the child has *breathed,* not that it has been *born alive.*

6. That by taking together the colour, volume, consistency, appearance of developed air-cells, absolute weight, and buoyancy of the lungs, we may be able to draw an inference whether the child has or has not breathed.

7. That if the lungs are fully and perfectly distended with air by the act of breathing, this affords a strong presumption that the child has been *born alive,* since breathing during birth is in general only partial and imperfect.

8. That when lungs have undergone perfect respiration, the air cannot be expelled by compression of the divided parts, so as to cause them to sink.

9. That the hydrostatic test can only show whether a child has or has not breathed—it does not enable us to determine whether a child has been born living or dead, or has died a violent death.

10. That the lungs of children that have lived after birth may *sink*

in water, owing to their not having received air, or to their being in a diseased condition.

11. That a child may live for a considerable period when no part or only a portion of the lungs has been penetrated by air.

12. Hence the sinking of the lungs (whether whole or divided) in water is not a proof that a child has been *born dead.*

13. That the lungs of children which have not breathed and have been born dead may float in water from putrefaction, or from artificial inflation.

14. That the lungs as situated in the chest undergo putrefaction very slowly; that, if but slightly putrefied, the air may be easily forced out by compression; and if much putrefied, either the case must be abandoned or other sources of evidence sought for.

15. That while lying in the chest, the fœtal lungs are not easily inflated, and that the difficulty in inflating them is great in proportion as the child is immature.

16. That lungs artificially inflated while in the chest usually resemble those organs in which respiration has been only imperfectly established.

17. That when the lungs are very heavy, and contain but little air, it cannot with certainty be inferred that respiration has been established. The facts, *cæteris paribus,* may be explained by supposing that the lungs were naturally heavy, and that they have been artificially inflated.

18. That the sinking of the lungs, as the result of the expulsion of air from them by compression, does not necessarily prove that the child was born dead. It merely proves that the air contained in them was derived either from artificial inflation, or from imperfect breathing.

19. That certain changes in the umbilical vessels, and the separation by a vital process and cicatrisation of the umbilical cord, as well as a general peeling or scaling-off of the cuticle, indicate live birth.

20. That the open or contracted state of the foramen ovale or ductus arteriosus furnishes no evidence of a child having been born alive. These parts may become closed and contracted *before birth,* and therefore be found closed in a child born dead; or they may remain open after birth in a child born living, even subsequently to the establishment of respiration.

21. That the absence of meconium from the intestines and of urine from the bladder are not proofs that a child has been entirely born alive, since these liquids may be discharged during the act of birth.

22. That the presence of farinaceous or other food in the stomach, or of foreign substances swallowed, proves that a child has been entirely born alive.

23. That the presence of blood, meconium, vernix caseosa, or the discharges in the stomach and air-passages, does not necessarily prove that a child was born alive.

A point occasionally arises as to how long did this child survive its birth. On this Dr. Taylor remarks:—

1. That the period for which a new-born child has survived birth cannot be determined by any certain sign for the first twenty-four hours.

2. That after this period an inference may be drawn from certain changes which take place progressively in the skin and umbilical cord

externally, and in the viscera on inspection; that these changes allow only of an approximate opinion within the first five or six days.

3. That the contraction of the ductus arteriosus, and the closure of the foramen ovale, take place from natural changes at such uncertain intervals as to render it difficult to assign a date of survivorship from the state of these parts.

VIOLENT OR CRIMINAL CAUSES OF DEATH.

We have now to consider those modes of death which are totally independent of the existence of congenital disease or other natural causes. A medical jurist should remember that there are certain forms of child murder which are not necessarily attended with appearances indicative of violence: these are suffocation, drowning, exposure to cold, and starvation. The evidence in many of the causes is naturally of the same nature as that which will be looked for in the case of an adult. The causes will, however, be treated in some detail with cases in the following order:—

1. Suffocation.
2. Strangulation.
3. Cold and exposure.
4. Starvation.
5. Intentional immaturity (abortion).
6. Violence by wounds internal and external.
7. Poisoning.
8. Drowning.
9. Deliberate neglect to tie the cord.
10. Burning.

1. Suffocation.

This is a common cause of death in new-born children (for overlaying of living infants, *vide* Vol. I.). A wet cloth may be placed over the child's mouth, or thrust into this cavity, either during birth or afterwards, and before or after the performance of respiration. To the latter case only could the term suffocation be strictly applied. A child may be thus destroyed by being allowed to remain closely compressed under the bed-clothes after delivery, or by its head being thrust into straw, feathers, dust, ashes, and similar substances. The appearances in the body are seldom sufficient to excite a suspicion of the cause of death, unless undue violence has been employed. There is commonly merely lividity about the head and face, with slight congestion of the lungs. A careful examination of the mouth and throat should be made, as foreign substances are sometimes found in this situation, affording circumstantial evidence of the mode in which the suffocation has taken place. Thus **wood, straw, feathers, dust, tow, or a hard plug of linen** may be, and in some cases have been, found blocking up the mouth and fauces, drawn into these parts by aspiration when the mouth of a child has been covered with such substances (see "Smothering," Vol. I., pp. 632 *et seq.*). If a child has lived sufficiently long to be fed, it may be accidentally suffocated by the entrance of portions of **food** into the windpipe and air-passages. The following case, in reference to a child which survived its birth thirty days, will throw a light upon this accidental cause of death.

An infant, thirty days old, was found dead in bed. The mother, stated that the child was healthy, and was put to bed after having sucked well at 7 p.m. the previous evening; also once in the night about 2 a.m. On awaking at 4.30 a.m. she found the child dead. It was lying at her right side—the farthest side from the father, and on its own left side looking towards its mother. When seen by Ross it was on its back; the hands were clenched, the lips blue and pouting, and the tongue thrust out a little way between them. There were no marks of violence or flattening of the features. The lungs and right cavities of the heart were distended with blood. The stomach contained a quantity of curdled milk. On opening the larynx a small quantity of the curd of milk was found resting on the vocal chords of the larynx and lining the upper two or three rings of the windpipe, thus completely blocking up the tube, which in calibre was not larger than a goosequill.

It appeared that on the previous day the child had frequently thrown up its milk; it had probably vomited it in the night while its face was turned towards the pillow, and had by aspiration drawn a portion of the curd of milk into the air-passages, and thus caused death by suffocation. An infant of this age would not have the power to relieve itself in such a position.

A new-born child may be suffocated by having its head held over **noxious vapours** such as the exhalations of a privy or of burning sulphur; and other poisonous vapours, *e.g.*, chloroform, may be used by a criminal without leaving any trace upon the body—except, possibly, that which may depend upon their peculiar odour. There are few of these cases of suffocation in which a medical opinion of the cause of death could be given, unless some circumstantial evidence were produced, and the witness were allowed to say whether the alleged facts were or were not sufficient to account for death.

On the other hand, if it be even clearly proved that death has been caused by suffocation, it must be remembered that a child may be accidentally suffocated, and the crime of murder falsely imputed (*vide* Vol. I., " Suffocation ").

Sometimes the body is found maltreated, with severe fractures or contusions on the skull, and marks of strangulation on the neck; concealed in a feather bed or privy; or cut up and burnt. This kind of violence may excite suspicion of murder and lead to the belief that the allegation of death from accidental suffocation is a mere pretence. But unless the case is of a glaring nature, the violence is considered to have been employed for the purpose rather of aiding delivery or concealing the birth of a child than of destroying it. In the present day these cases of death from accidental suffocation, when properly investigated, can never involve an innocent woman in a charge of murder, although the facts may show in some instances that the death of the child was really due to great imprudence, gross neglect, or culpable indifference on her part. Thus a woman knowing or having reason to believe that her delivery is impending is secretly delivered at night. The child is born under the bedclothes; no effort is made to remove it, and it necessarily dies from suffocation. In some cases of this kind a woman may be unable to make the necessary exertion to uncover the head of the child so as to allow it to breathe. In others, however, there is no desire to save life, and the child is found dead. A case of this kind occurred to Dohrn, in which he was able to show that the child had breathed and had probably come into the world alive, but had died from wilful neglect. The woman was conscious of her delivery, but asserted that the child showed no sign of life after birth (Horn's *Vierteljahrsschr.*, 1867, 2, p. 84). Dohrn's report furnishes a model for the investigation of cases of this kind. Such a case may not be considered as murder, but it involves something more than a mere "concealment of birth." Some of our judges have already taken the course of directing the jury to find a verdict of manslaughter when there was proof from the general evidence of culpable neglect or reckless indifference to the life of her child on the part of the woman.

The following case (*R.* v. *Mortiboys*) will show that in this country, even when the evidence is very strong against a person, the circumstances will be most favourably interpreted towards the accused. In this instance it was proved that the body of the child was discovered, lying on its abdomen, in a box containing wool, with its face raised and its mouth open. A red worsted comforter had been passed twice round the neck, and was tied a second time in a single knot over the chin. In the mouth, which was open, was found a small quantity of fine flocks of wool. The medical evidence showed that the child had been born alive, the left lung being fully inflated. The brain was congested. There was no mark produced by the ligature on the neck, either externally or internally. Death was referred to obstructed respiration (suffocation), caused partly by the ligature and partly by the wool in the mouth; but the latter was considered to be the more active cause. In the defence it was urged that the ligature could not have produced strangulation, because the comforter was tied upon the chin; that the medical evidence showed the wool in the mouth to have been the immediate cause of death; and this was probably taken into the mouth by the child itself in the instinctive act of breathing, and not put there by the prisoner for the purpose of suffocation. The child had probably been placed carelessly on the quantity of wool, into which it had sunk by its own weight, and this had caused its death. The judge in charging the jury said that had the prisoner intended to choke the child with the wool, she would have inserted enough to fill its mouth. The prisoner was acquitted.

In this case, admitting that the evidence did not bear out the charge of murder, still it is clear that death was caused by the child being placed on its face, with a ligature round the neck, in a close box filled with wool. A new-born infant could no more breathe in such a position than if the wool had been directly thrust into its mouth. Admitting the facts to have been as represented, there appears to have been in this case something more than an accident; for the prisoner must have known that her infant was not likely to live long under such circumstances, and had the child been a week or a month old, she would probably have been convicted of manslaughter or murder.

A case of alleged child murder by suffocation was reported by Easton (Cormack's *Edin. Jour.*, February, 1845, p. 89). The child in this case was suffocated by a quantity of mud having been forced into its mouth and throat; its presence in the gullet was incompatible with its having entered by gravitation. In the case of Macintyre (Glasgow Aut. Circ., 1829) several small pieces of straw were found in the stomach of a child, of the same kind as those which were in the bed where the birth took place. In another case it was found that a mass of dough, or bread-pulp, had been forcibly impacted in the throat and larynx of the child, and it was found to be accurately moulded to the parts (*Edin. Med. Jour.*, December, 1855, p. 521). In one instance a plug of flax was discovered in the mouth ("Ann. d'Hyg.," 1863, 2, p. 395).

Any foreign substance found in the air-passages should be most carefully examined. Dohrn gives a caution in this respect from a case which fell under his notice :

> The body of a new-born child was found in a marshy soil, and from an examination it was stated that it had breathed, had died from suffocation, and had been buried where the body was found. This opinion was chiefly based on the discovery of a dark-coloured substance in the windpipe and bronchial passages, which was pronounced to be earth from the marsh in which the body was buried. The woman who gave birth to the child said she had been suddenly delivered over a tub, used for the purpose of a privy, that the child fell into the excrementitious fluid, and that she afterwards removed the body and buried it in the place where it was discovered. Her story was corroborated by a subsequent examination made by Dohrn, for he found that the dark substance present in the air-passages and in the gullet was not part of the earthy soil in which the body had been buried, but dried fæcal matter. This discovery of the real nature of the substance exonerated the woman from the charge of murder (Horn's *Vierteljahrsschr.*, 1867, 2, p. 98).

Post-mortem Appearances in Smothered Infants.—These are fully described, in reference to adults, Vol. I., p. 626 ; and they are similar in new-born children, provided respiration has been fully performed. Great importance is to be attached to the discovery of subpleural or punctiform ecchymoses on the lungs of children ; and also to small effusions of blood on the surface and in the substance of the thymus gland. If the lungs float on water, as the result of breathing, then the appearances described may be met with ; but in three instances Tardieu met with similar appearances in children whose lungs had not received air, and sank when placed on water. They were children prematurely born, and under conditions which prevented full vital development. One born in the Hospital of Riboisière uttered several cries, but, in spite of this, the lungs contained no air. The subpleural ecchymoses met with in children under these circumstances were ascribed by Tardieu to the efforts made to breathe after birth. They are, however, perhaps more commonly produced during parturition by obstructions to the fœtal circulation brought about by pressure on the umbilical cord, and consequent asphyxia. Dr. Stevenson has seen them produced in such a case to a marked degree.

Much has been written touching this post-mortem appearance in death from suffocation in new-born children. A reliance on the presence of these punctiform ecchymoses may, it appears, mislead a medical jurist, as in the following case published by Douillard and Gallard.

> A child was born at the seventh month, and died in about six days from congenital weakness. The lungs, which were removed for the sake of experiments, presented on their surface eighteen or twenty of those small subpleural ecchymoses which have been supposed to be characteristic of death from suffocation ("Ann. d'Hyg.," 1872, 1, p. 201).

The mistake is made of assuming that subpleural ecchymoses indicate the *cause* of the asphyxia ; they of course do nothing of the sort. They suggest that the person in whom they are found died from want of air in the lungs, but by themselves afford not even a hint as to why this was, and it may as well be from disease or inability to breathe as from any violent cause for asphyxia. The editor has already insisted upon this (*vide* Vol. I., p. 622), but it cannot be too often repeated.

A servant girl had given birth to a healthy child. This child was found alive about a quarter of an hour afterwards in a privy, and it lived a few minutes after the discovery. Its jaw was broken, its cheek torn, and the mouth contained ashes, some of which were found in the back part of the throat. The body was blanched, and there had evidently been a great loss of blood from the wounds and the torn umbilical cord. There was no engorgement of the lungs, nor any subpleural ecchymoses. The lining membrane of the trachea was stained with ashes, and a small cinder was found in the left bronchus.

In this case there was no question respecting live birth, as the child was living when found, but what was the cause of death, and was this accidental or the result of violence wilfully applied after birth? In the opinion of Moore, the mouth of the child had been forcibly torn open and filled with ashes in order to suffocate it. These ashes must have been drawn by aspiration into the air-passages, and death was caused partly by suffocation and partly by hæmorrhage from the wounds, the child's body being bloodless. The condition of the lungs was not inconsistent with death from suffocation. For some remarks on death from suffocation in child murder, with reports of cases, see a paper by Séverin Caussé, "Ann. d'Hyg.," 1869, 2, pp. 122, 443.

The question involved in this, and in all similar cases, is the following:—Does the law regard the wilful *prevention of respiration* as murder? There cannot be the slightest medical doubt that living children are occasionally thus destroyed in the act of birth: they die, not from the actual infliction of violence, but because, either through accident or design, the performance of that act which is necessary to maintain existence when the child is born is prevented. Such a case has not yet been decided, although, from the dicta of our judges, it would probably involve a charge of murder.

In a case published by Wharrie, a pregnant woman, thinking she was about to have a motion, sat on an earthen pitcher, two feet in depth, which happened to be full of water. She was there delivered of a child, which fell into the water, and was thus prevented from breathing. The child was full-grown, and its body was free from putridity. It weighed six pounds, and measured twenty inches in length. There were no external marks of violence, and the navel-string had been *tied*. The lungs weighed two and a half ounces; they were of a liver-colour, contained no air, and sank in water. The medical opinion was that, from the size and general appearance of the child, and the state of the parts discovered on dissection, it was mature, that it had not breathed, and life might have been either wilfully or accidentally destroyed. The examiners declined giving an opinion, based on the sinking of the lungs, that the child had been born dead. The woman was not prosecuted, probably on the assumption that the death of the child might have been accidental.

As Wharrie observes, there was no medical proof that the child was born alive; although there was a strong moral presumption that its life was destroyed in the act of birth (*Edin. Month. Jour.*, October, 1845, p. 796).

2. STRANGULATION.

The destruction of a new-born child by strangulation is not an unfrequent form of child murder: and here a medical jurist has to encounter the difficulty, that the strangulation may have been accidentally produced by the twisting or coiling of the umbilical cord round the neck while in the womb (see p. 242), or during delivery. We must not hastily conclude, from the red and swollen appearance of the head and face of a child when found dead, that it has been destroyed by strangulation. There is no doubt that errors can easily be made with respect to this appearance. When a child's head or face looks swollen, and is very red or black, the vulgar, because hanged people look so, are apt to conclude that it must have been strangled. But those who are in the practice of midwifery know that there is nothing more common in natural births, and that the swelling and deep colour go gradually off if the child live but a few days. This appearance is particularly observable in those cases where the navel-string happens to gird the child's neck, and where its head happens to be born some time before its body.

Strangulation by the Navel-string.—Strangulation by the navel-string can, in the medico-legal sense of the term, refer to those cases only in which it becomes firmly twisted round the neck *after* the respiratory process has been established. This is rather a rare occurrence, because under these circumstances death more commonly takes place by compression of the cord, and by the consequent arrest of circulation before the act of breathing is performed. The internal appearance met with in death from this cause is a congested state of the cerebral vessels, and ecchymotic spots on the surface of the heart, lungs, and thymus gland. The presence of ecchymosis on the scalp, as well as of lividity of the face, is very common in new-born children when the labour has been tedious and difficult; and therefore, unless there were some distinct marks of pressure about the neck, with a protrusion of the tongue, such appearances would not justify any suspicion of death from strangulation.

It has been supposed that the strangulation produced by the wilful application of any constricting force to the neck would be known from the accidental strangulation caused by the cord, by the fact that in the former case there would be a livid or ecchymosed mark or depression on the neck. But it may be objected to this view that such a mark is not a constant accompaniment of homicidal strangulation. Severe violence to the neck commonly produces in the seat of constriction not only ecchymosis, but a laceration of the skin, muscles, and windpipe; but these appearances are not always found.

In 1861, Evans communicated to the author the particulars relating to a new-born child which was destroyed by strangulation. Great violence had been used, but there was no trace of discoloration in the course of the ligature, or of ecchymosis in the tissues beneath. The muscles compressed were very dark in colour. The skin had been so compressed as to give the impression of coarse towelling of a close texture having been used.

In most cases when a ligature is applied during life the skin on each side becomes much swollen, and presents an œdematous character. This indicates an application of violence when there is still some vital power in the body of the child. The navel-string itself may be used as a means of constriction, and the mark or depression may sometimes present an appearance of ecchymosis. Among various cases which might be quoted in support of this statement is the following:—

A lady was in labour with her first child. The labour was of a lingering kind, owing to the size of the head; and the child came into the world dead. The navel-string was found coiled three times round the neck, passing under the right armpit; and upon removing it, *three parallel discoloured depressions* were distinctly evident. These extended completely round the neck, and corresponded to the course taken by the coils. The child appeared as if it had been strangled (*Med. Gaz.*, vol. 37, p. 485).

Had this child been born secretly, and the cord removed, this state of the neck might have created a strong suspicion of homicidal violence. Strangulation after birth could not, however, have been alleged, because there would have been no proof of respiration. When a blue mark is found on the neck of a child whose lungs retain their fœtal characters, it is fair to presume, *cæteris paribus*, that it has been accidentally occasioned by the twisting of the umbilical cord during delivery.

Price communicated to the same journal the account of a case in which the cord, which was short, was so tightly twisted around the neck of the child that he was compelled to divide it before delivery could be accomplished. There was in this instance a deep groove formed on the neck, conveying the impression to himself and a medical friend that, in the absence of any knowledge of the facts, they would have been prepared to say that the child had been wilfully strangled by a rope (*Med. Gaz.*, vol. 38, p. 40).

A diagnosis might have been formed, as in the preceding case, by examining the state of the lungs.

Mutter met with a case in which a child was born dead, and the cord was tightly twisted round its neck; when removed, the neck exhibited a livid circle of a finger's breadth, smooth and shining; but on cutting into this mark, no subcutaneous ecchymosis was found (*North. Jour. Med.*, January, 1845, p. 190). In *R.* v. *Martin* (Lewes Lent. Ass., 1860), the material question was, whether a mark round the neck had been caused accidentally by the navel-string: this was denied by the medical witness. This question also arose in another important case (*R.* v. *Pyne*, Gloucester Wint. Ass., 1858).

Williamson has directed attention to an important fact connected with the state of the lungs in a new-born child, and the medical opinions which may be expressed from their condition as furnishing evidence of live birth. Referring to Price's case, in which the cord was tightly twisted round the neck of the child, he states that in similar cases which have occurred to himself the child has breathed immediately on the birth of the head; but, owing to the shortness of the cord, the child would have been strangled and born dead unless he had divided it. Thus, then, a child might die apparently strangled, and not be born alive, although it might have so breathed during birth that the lungs would present all the characters of respiration. If the circumstances were not known, a medical man might be led to say that the child had been born alive, and had been destroyed by strangulation (*Edin. Med. Jour.*, February, 1858, p. 714).

From these cases it will be perceived that ecchymosis in the depression furnishes no distinction between constriction produced by criminal means and that which may result accidentally from the navel-string. In the following case a woman charged with the murder of her child by strangulation appears to have been unjustly condemned.

The child had fully and perfectly respired, the lungs weighed one thousand grains, and, when divided, every portion floated on water, even after firm compression. There was a circular depression on the neck, which was superficially ecchymosed in some parts. From an investigation of the facts, this appeared to have been a case in which a mark on the neck was accidentally produced by the umbilical cord during attempts at self-delivery on the part of the woman : she was nevertheless convicted, chiefly from the opinion expressed by two medical witnesses, that a soft and yielding substance like the umbilical cord could *not* produce a depression and ecchymosis on the neck of the child during birth. They attributed the mark to the wilful application of a ligature like a garter ; but the experiments of Négrier clearly show that the umbilical cord has sufficient strength to produce fatal constriction.

In another instance the navel-string and the membranes were actually used by the woman as a means of strangulation : the child had not breathed, but was thereby prevented from breathing. There was superficial ecchymosis on each side over the muscles of the neck. The defence was, that the child was born with the cord around its neck, and that it was from this circumstance accidentally strangled ; but the medical evidence tended to show that the cord had been violently stretched, and employed as a means of strangulation. The child had *not breathed*, and the medical witnesses considered that it had been born dead, owing to the violence used by the woman. The cause of death here was certainly not strangulation, but arrested circulation.

In the meantime, the case proves that ecchymosis (a blue mark) may be the result of violent constriction produced by the navel-string.

A case occurred in which the navel-string, which was of its full length, had been used as a means of strangulation. It was twisted once round the neck, passed under the left arm, over the shoulders, and round the neck again, forming a noose or knot, which, pressing upon the throat, must have caused strangulation, as the tongue was protruded, and there were other clear indications of the child having been strangled. The hydrostatic test applied to the lungs proved that respiration had been performed.

When the mark on the neck is deep, broad, much ecchymosed, and there is extravasation of blood beneath, with injury to the muscles or windpipe, and ruffling or laceration of the skin, it is impossible to attribute these appearances to accidental pressure by the navel-string. The lividity produced by it in the cases hitherto observed has been only slight and partial, and unaccompanied by laceration of the skin, or injury to deep-seated parts.

It has been doubted whether a child can be born with the navel-string so tightly round the neck as to produce great depression of the skin and ecchymosis, *i.e.*, to simulate homicidal strangulation, and at the same time perform the act of respiration fully and completely. It is important, therefore, when this hypothesis is raised in order to account for a suspicious mark on the neck, to examine closely the state of the lungs. Unless the cord is designedly put round the neck of the child *after* the head has protruded, the effect of the expulsive efforts of the uterus, when a coil has become *accidentally* twisted round the neck, would be to tighten it, compress the vessels, and kill the child by arresting the placental circulation, at the same time that this pressure would effectually prevent the act of breathing. Hence the lungs usually present the appearances met with in stillborn children; but the case which occurred to Williamson (*supra*) shows that this state of things may sometimes occur, and that a child may breathe, and die strangled by the umbilical cord before its body is entirely born. A careful examination of the neck will show whether a ligature has or has not been wilfully applied after birth.

In examining a suspicious mark round the neck of a new-born infant, it should be noticed whether it does not, by its form or course, present some peculiar indentations or irregularities which may render it certain that some kind of ligature has been wilfully employed after birth. When it is found that a child has fully breathed, the presence of a deeply ecchymosed or an œdematous mark on the neck, with injury to the skin and muscles, is, *cæteris paribus*, presumptive of homicidal strangulation. Death from accidental constriction by the cord during delivery should, as a general rule, leave the lungs in their fœtal condition.

Marks on the neck of a child may be accidentally produced by the navel-string without necessarily destroying the child's life (cf. *supra*).

There is much less risk of strangulation from twisting of the cord than is commonly believed. Out of 190 cases, Churchill found the cord round the neck in fifty-two children, and the shortest cord so disposed was eighteen inches long; Négrier found it round the neck in twenty cases out of 166 natural labours ("Ann. d'Hyg.," 1841, 1, p. 137).

Strangulation by means other than the Cord.—The *appearances* met with in the body in death from strangulation have been elsewhere considered (Vol. I., pp. 681 *et seq.*). The facts of a case will serve to show the appearances as they may present themselves in a new-born child:—

A maid-servant in a family was secretly delivered of a child. When the body was found, it was observed to be full-grown, and there was a piece of tape which went twice round the neck, and had been tied tightly in a bow. The tongue protruded between the lips; two deep furrows were found round the neck after the removal of the tape; there was great œdema of the skin between and above them, and the right hand was clenched. The lungs were of a light-red colour: they filled the chest, were highly crepitant, and floated readily on water, even when divided into sixteen pieces, and these had been submitted to strong pressure. They weighed, however, only 626 grains. The heart was healthy; the right side contained some coagula of blood, whilst the left side was empty; the foramen ovale was open. The scalp was much congested, the congestions almost amounting to small effusions of blood; the pia mater was also congested. The inferences drawn from these facts were, that the child had been born alive, and that it had died from strangulation.

A discoloration may be in detached spots or patches—situated in the fore part of the neck, and evidently not arising from the employment of any ligature. These marks may depend on the forcible application of the **fingers** to the neck of the child, and the indentations have been known to correspond—a fact which has at once led to a suspicion of the cause of pressure and the mode of death. Impressions of nails or fingers on the neck do not necessarily imply that they have been caused by an attempt at strangulation. Accident during self-delivery may lead to their production (see case, Horn's *Vierteljahrsschr.*, 1868, 2, p. 308). At the same time it should be borne in mind that a superficial mottling of the skin occurs after death in new-born infants, in parts where moderate pressure only may have been accidentally made. This would not be attended with ecchymosis, and its true nature would be at once determined by comparing the discoloured spots with the surrounding skin. It may be alleged that such marks have been accidentally produced:—1. By the forcible pressure produced by the child's head during labour, an explanation which is highly improbable, if respiration has been performed—although a child has been known to breathe in breech-presentations, while the head was still in the vagina. 2. They will be more commonly referred to a violent attempt made by a woman at self-delivery, during a paroxysm of pain. This explanation is admissible, so long as it is confined to injuries which, by any reasonable construction, might be received during labour; but supposing the marks to have been *certainly* produced after the complete birth of the body, it will not of course apply. The case of *R.* v. *Ancliffe* (Nottingham Lent Ass., 1842) is in this respect worthy of attention.

The evidence proved that the prisoner was delivered of a child under much suffering, on a stone floor, and in the presence of another woman—a witness. The child was born alive, and was heard to cry several times. The witness left it in charge of its mother, and on returning shortly afterwards, she found it dead with black marks upon its throat. The midwife, who separated the child from the mother, deposed that it gave a sort of half-cry: she thought it was dead when she first saw it, and the marks on the neck were not more than a woman might have caused in attempting to deliver herself. The medical evidence proved that there were many ecchymosed marks about the throat of the child, as well as on the right side of the neck, and blood was effused beneath them. The marks might have been produced by the fingers; death had been caused by pressure on the windpipe. The judge left it to the jury to say whether the marks of violence might not have been unconsciously inflicted by the prisoner herself during labour. The jury returned a verdict of "not guilty."

Isolated or detached marks of ecchymosis, as from local pressure of the fingers and thumb, cannot be set down to the twisting of the navel-string. Other accidental causes may, however, here come into operation. In *R.* v. *Sampson* (Bodmin Lent Ass. 1853), it was proved that there was a mark on the neck of the child, and it was charged against the prisoner that this had been caused by pressure of the fingers, *i.e.*, by pinching the windpipe. The mark was described as being of a red colour, and an inch and a quarter in length; it was suggested in defence that it might have been produced by the tying of a cap. The medical witness stated that it was below the spot where a cap would be generally tied, but the mark might by possibility have been occasioned by the knot of a tie. The prisoner was acquitted.

On the other hand, in homicidal strangulation, much more violence being used than is necessary for destroying life, we may commonly expect to find great ecchymosis and extensive injury to the surrounding soft parts. On some occasions all difficulty is removed by the discovery of a rope, tape, or ligature, tied tightly round the neck; or, if this be not found, the proofs of some ligature having been used will be discovered in the indentations or irregularly ecchymosed spots left on the skin—the depressed portions of skin being generally white, and the raised edges livid or œdematous.

Was the Constriction before or after Death—before or after Respiration?—A witness is sometimes asked on these occasions whether the ligature or the fingers had been applied to the neck of a child before or after its death, or before or after it had breathed. So far as external marks of strangulation are concerned, there is no difference in the appearances, whether the constriction takes place during life, or immediately after death, while the body is warm. Casper's experiments render it probable that when a constricting force is applied to the neck of a dead child, at any time *within an hour* after death, the marks cannot with certainty be distinguished by any appearance from those made on a living body (*vide* Vol. I., p. 686). With regard to the second point, it may be stated that whether the child has breathed or not, provided it is *living* and the blood circulating, marks of violence on the neck will present precisely the same characters. The following instance is related by Casper:—

The body of a new-born child was found concealed in a cellar, and the mother was charged with having murdered it. She confessed that she had heard the child cry at the birth, but that it soon died. In about *an hour* afterwards she tied tightly round its neck a band made of a few straws, which she hastily twisted together, in order, as she alleged, "to prevent it from awaking." On the fifth day the body was examined: the child was mature, well-formed, and had evidently breathed. The examiners referred death to strangulation, and the woman was convicted. An appeal was made against this sentence, and Casper's opinion was called for on the propriety of the medical inference of strangulation during life, from the mark found on the neck. The witnesses had stated "that each straw in the band had produced a well-defined depression, which was whiter than the surrounding skin, while the little folds or elevations between the straws were red; and on cutting into those reddened portions a slight effusion of blood was found beneath." Casper gave his opinion that this effusion (ecchymosis) might have resulted from the application of the straw-band soon after death while the body was warm; and the circumstantial evidence allowed that the ligature might have been applied at any time within an hour after death. Hence he declared that there was a want of proof that this child had died from strangulation. In consequence of this opinion the punishment was mitigated.

It is impossible to deny the correctness of the inference drawn by Casper, since the mark was undoubtedly such that it might have been produced either before or recently after death, while the body was warm. Which of these two suppositions was the more probable, and whether it was more likely that a ligature should be put round a child's neck an hour *after* death to prevent it from awaking, or *before* death for the alleged purpose of destroying it, it was of course for a jury and not for a medical witness to decide.

When such a plea as this is raised, it is a fair matter for a jury to consider the motives of human conduct, and to judge of such a defence on the principles of common sense.

In the case of *R.* v. *Wren* (Winchester Lent Ass., 1840), the medical evidence went to show that the child had breathed, and was born alive. There was a piece of tape tied round its neck very tightly, and fastened behind, and there was a discoloration of the skin beneath; the tongue was livid and swollen, and blood was effused beneath the scalp. The medical witness admitted that the mark on the neck might have been produced after death; and as he could not therefore positively say that the child had been destroyed by strangulation, the prisoner was acquitted (see also *R.* v. *Hyland*, C. C. C., August, 1844). In *R.* v. *Green* (C. C. C., February, 1860), the body of the child was found with a riband round its neck, so tightly applied that the parts on each side were swollen. Death was referred to strangulation, but it was suggested in the defence that the riband-ligature might have been placed there as an ornament or as part of the dress; and as the post-mortem examination of the body was not made until forty-eight hours after death, it was assumed that the tightening of the ligature was only apparent, and the result of a swelling of the parts after death. The jury acquitted the prisoner. In a similar case (*R.* v. *Morgan*, C. C. C., April, 1865), a string such as is used for securing parcels was tied very tightly round the child's neck. The lips were swollen, the face was puffy, the tongue protruded, and there was a deep indentation round the neck in the course of the ligature. The lungs were found to be fully distended with air, so as to leave no doubt that the child had been born living, and had been destroyed by strangulation.

The editor leaves the above cases undisturbed, for though they are old they illustrate very aptly the difficulties of the position. In 1899 he himself had to give evidence in a somewhat similar case: the baby had been kept in a bandbox under the (unmarried) mother's bed for six months; the body was mostly adipocere, but there was a piece of tape tightly tied round the neck. Positive evidence of strangulation was wanting, and much less was there evidence of whether the tape was placed there before or after birth.

Was the Constriction produced while Circulation was still active?—The answer to this question should give a complete solution to the question, Was the child *alive* when strangled? and as a matter of fact it does so, but not to the question, Was it *born* when strangled?

Dr. Taylor, at this point in previous editions, went on to consider whether proofs of strangulation while the child's circulation was still active offered proofs of an independent circulation in the child. Inasmuch as from the first day of conception **the child's circulation is always independent of the mother's,** such a discussion is quite out of place, and only serves to confuse the issue, which is simply this: *If the child is strangled during or immediately after birth, medical evidence alone is quite insufficient to determine whether it was strangled before or after complete birth.*

He then considered if it were possible to determine whether **the cord had been cut before or after strangulation,** an equally absurd task; but the question was raised in the case of *R.* v. *Morgan* (C. C. C., April, 1865, see p. 423), and decided by Shee, J. In *R.* v. *Raven*, however (Warwick Lent Ass., 1865), a different view appears to have been taken by Martin, B. It was proved that a child was born alive, was placed on the bed, and cried for five or ten minutes. Fracture of the skull was the cause of death, and, according to the statement of the mother, the injury was inflicted after the child was born, but *before* the umbilical cord was severed. The judge directed the jury that, if they believed the injuries were inflicted at that time, and that the child died, after the cord was severed, from the injuries previously received, that would be murder or manslaughter according to the circumstances. The jury acquitted the prisoner.

The following case is reported (*Lancet*, 1867, 2, p. 576). The child was mature; the umbilical cord had not been tied; it was torn and jagged at the end. There was a bloody discharge from the mouth and nostrils. The mouth was open; the tongue protruded between the lips. There was general lividity of the head and face. On the lower part of the neck there was a well-defined circular mark or indentation about two lines in breadth. The mark corresponded to a stay-lace, with which the bundle containing the dead body of the child was tied. The skin in the indented part was thin, semi-transparent, and parchment-like. There were linear impressions of the threads of the tape to be seen on it. There was no extravasation of blood. The lungs filled the chest; they were of a bright-red colour; they weighed twelve drachms. They floated on water entire, as well as when divided into small pieces; and they floated when the divided portions were compressed. They crepitated on cutting, and when the portions were squeezed, frothy blood escaped. The cavities of the heart contained dark blood, and the whole nervous system was gorged.

In the opinion of the medical witness these facts established:—1, that the child was born alive; 2, that it died from strangulation; 3, that the mark on the neck was not produced by the navel-string, but by some ligature intentionally applied. In this case full and perfect respiration and an independent circulation in the child were proved. All this was admitted, but the question at the trial was whether the ligature was applied to the neck before or after the entire birth of the child. This did not admit of a positive answer, and the prisoner was acquitted.

It may be an important question whether, in these instances, the **absence of any mark or discoloration** of the skin by a ligature should be taken as evidence of the means of constriction **not having been applied during life.** What we are entitled to say from observed facts is, that ecchymosis from the ligature is not a necessary consequence of constriction, either in a living or a dead child; although we might expect that there would be few cases of child murder in which, when strangulation was resorted to, there would not be some ecchymosed mark or discoloration, chiefly on the presumption that great and unnecessary force is suddenly applied. Besides, it is not improbable that a slighter force would cause ecchymosis on the skin of a new-born infant than would be required to produce an effect on that of an adult. When there is no mark from a ligature, an attempt may be made to show that death could not have been caused by strangulation, as in the following case:—

(*R.* v. *Hagg*, Carlisle Sum. Ass., 1841.) The deceased child was discovered with a tape tied tightly round its neck. It was full-grown and healthy, and had been presumably born alive, as respiration had been fully established. The lungs filled the chest, floated on water, and crepitated when pressed. From the livid appearance of the face and neck, the congested state of the brain, an effusion of blood on the surface, and the ligature round the neck, the witnesses were of opinion that the child had died from strangulation. One witness said the ligature had produced no mark of discoloration on the neck, while others said it was perceptible. The mark could not have been very apparent, or there would have been no discrepancy on this point. It was urged in the defence that the child could not have died from strangulation, because a tape tied so tightly round its neck as to cause death in this manner would necessarily leave a discoloration of which no person could have any doubt. The prisoners were convicted.

Was the Strangulation caused by efforts at Self-Delivery?—Skrzeczka reported two cases of some interest in which effusions of blood were found beneath the muscles of the neck of new-born children. Such an appearance might induce a medical witness to affirm that great violence had been applied to the neck with criminal intention. The fact is, however, they may be often owing to the efforts made by the woman in self-delivery.

The suggestion in the defence in *R.* v. *Morgan*, *supra*, was that the woman had employed the ligature for the purpose of assisting her delivery. Shee, J., in charging the jury, said they "must be satisfied that the child had died from strangulation, that the prisoner strangled it intending to destroy it, and that the child lived after it was entirely detached from the person of its mother except by the umbilical cord.

There was no doubt the child had died from strangulation, and that the ligature was put round its neck by the prisoner. If, however, she tied it to assist the birth, and in so doing unintentionally destroyed the life of the child, she was not guilty on the capital charge; but if she tied it with the intention of destroying it, or if she tied it after the child was fully detached (except by the umbilical cord) with that intention, then she was guilty of murder."

Lankester speaks of a case, within his own knowledge, where a child was found strangled with a stocking tied tightly round its throat. The woman who was charged with the murder was acquitted on the ground that she might have tied the stocking round the neck of the child in order to assist her in delivering herself. In another case (*R.* v. *Baker*, C. C. C., August, 1866), the medical man who examined the dead body of the child gave the following account of the appearances:—The tongue was swollen, the eyes protruded, and a tape was passed *three times* round the neck. It had been passed once round and *double knotted*, and then passed round twice and again double knotted on the left side of the neck. On removing the ligature there was a deep indentation in the neck, and much discoloration. The results of further examination convinced him the child had been born alive, and that it had died from strangulation. In cross-examination he said he could not say whether the child was completely separated from the mother when the strangulation took place.

Counsel for the defence then asked what evidence there was on which the jury could come to the conclusion, either in point of fact or of law, that a murder had been committed at all. There was no doubt, he said, the child had died of strangulation produced by the ligature found round the neck; but he argued that the strangulation had been caused in the efforts of the mother to deliver herself when she was in all the agonies and throes of parturition, the ligature having been resorted to by her to aid the delivery. The woman was acquitted.

Juries are ready to act upon any suggestions to account for marks of violence on the neck of a new-born child.

In *R.* v. *Ashton* (Lewes Lent Ass., 1858), it was proved by the medical evidence that the child was found dead in the soil of a privy, with a piece of riband tied tightly round the neck, the mark of a bruise on the head, two deep cuts in the throat, and about seventeen punctured wounds on the body, of which one had penetrated the heart. The medical witness stated he had no doubt the child was born alive, and that these injuries were the cause of death. The defence suggested that there was no proof of existence after entire birth of the body, and the injuries found on the child were "very probably the result of accident in the course of self-delivery by an unhappy young creature like the prisoner." The jury accepted this inconsistent view of the medical facts, and acquitted her. In *R.* v. *Parkinson* (Liverpool Lent. Ass., 1859), some suspicious marks on the neck of a child were referred to the accidental tightening of the string of a cap. The cases of *R.* v. *Money* (Norfolk Sum. Ass., 1858), and *R.* v. *Grady* (Liverpool Lent Ass., 1858), furnish additional illustrations of the impunity with which new-born children may be destroyed by strangulation.

In such cases the only possible chance of proving that the ligature was placed round the neck from criminal motives lies in an examination of the material, the position, and the nature and number of the knots, any one of which may possibly give a very definite and positive piece of evidence, but it must be confessed that the chances that any of them will do so are very slender. To take an extreme supposititious case: suppose the material to be such that it could be proved that it only existed in a distant room and that the knots had been tied with great care under the chin (points very strongly suggestive of murder), would any medical witness care to swear that it was impossible for the mother while in labour to have walked to the distant room and then tied the ligature round the presenting head and neck. For other remarks *vide* Vol. I., pp. 685 *et seq.*, where homicidal strangulation is dealt with.

Accidental Marks resembling those of Strangulation.—On the fore part of the neck of a child a mark or depression is sometimes accidentally produced by forcibly bending the head forwards on the chest, especially when this has been done repeatedly and recently after death, while the body is warm. It may occur, also, as an accident during labour. Such a mark must not be mistaken for the effect of homicidal violence.

Among marks simulating violence, which are sometimes found on the necks of new-born children, Harvey has pointed out one of a singular kind:—

> He was present at a delivery in which a child was expelled rather suddenly; and after making two or three convulsive gasps, it died. Whilst endeavouring to restore animation, he observed a bright-red mark extending completely across the upper and fore part of the neck, from one angle of the lower jaw to the other, as though it had been produced by strangulation with a cord, except that the mark was not continued round to the back of the neck. It was of a vivid red colour, and not like a bruise or ecchymosis; it had very much the appearance of a recent excoriation. It was most clearly defined in front, where it was about a quarter of an inch in breadth, and it became diffused at the sides. The face was not swollen, and there was no fulness of the veins (*Med. Gaz.*, vol. 37, p. 379).

A distinction in this instance might have been based upon the colour of the mark, the unabraded state of the cuticle, and the absence of congestion of the face and venous system. Nevertheless, the case is of importance, and the facts should be borne in mind. Another case, which was the subject of a coroner's inquest, was published in the same journal (vol. 37, p. 530), in which red marks on each side of the nose of a new-born child were mistaken for the effects of violence applied to the nostrils during a supposed attempt at suffocation. Rose examined them closely, and considered that they were nævi (mother's marks), and had nothing to do with the death of the infant.

Dr. Taylor summed up the matter of strangulation in the following paragraphs:—

1. That congestion of the face and head in a new-born child is not a proof of death from strangulation.
2. That a child may be strangled during birth by the accidental twisting of the navel-string round its neck.
3. That the navel-string, like any other ligature, may produce a livid or ecchymosed depression on the neck.
4. The marks on the neck, arising from accidental causes, may resemble those which arise from strangulation.
5. That the local effect of constriction on the neck, either by the navel-string or any other ligature, is the same if the child be *living*, whether it has or has not breathed.
6. That the effect is the same whether the child has been *partially* or *entirely* born.
7. That the effect of a ligature on the neck of a *living* child is the same whether the navel-string has or has not been severed.

8. That a new-born child may die from strangulation, without this fact being necessarily indicated by ecchymosis on the neck. This depends on the nature of the ligature, and the amount of force used.

3. Cold and Exposure.

A new-born child may be easily destroyed by simply exposing it uncovered, or but slightly covered, to a cold atmosphere. In a case of this kind there may be no marks of violence on the body, or these may be slight and evidently of accidental origin. In death from cold the only appearance occasionally met with has been congestion of the brain, with or without serous effusion in the ventricles. (See "Cold," Vol. I., pp. 575, *et seq.*) The evidence in these cases must be purely circumstantial. The medical witness may have to consider how far the situation in which the body was found, the kind of exposure, and the temperature of the air, would suffice to account for death from the alleged cause. There is no doubt that a new-born child is easily affected by a low temperature, and that warm clothing is required for the preservation of its life. An inspection of the body should never be omitted on these occasions, because it might turn out that there was some cause of natural death which would at once do away with the charge of murder. Admitting that the child died from cold, it becomes necessary to inquire whether the prisoner exposed it with a malicious intention that it should thus perish. Unless wilful malice be made out, the accused cannot be convicted of murder. In the absence of proof of any wilful intention to destroy the child, there may have been, however, such a degree of culpable negligence or reckless indifference on the part of the woman as to justify a conviction for manslaughter. In general, women recently delivered do not expose their children for the purpose of destroying them, but for the purpose of abandoning them; hence it is rare to hear of convictions for child murder where cold was the cause of death, although some medical jurists have called this infanticide by *omission.*

A case of infanticide, as a result of exposure to cold, with an account of the appearances in the body, is reported by Otto (Horn's *Vierteljahrsschr.*, 1866, 2, p. 148).

4. Starvation.

A new-born child kept long without food will die, and no evidence of the fact may be derivable from an examination of the body. There may be no marks of violence externally, nor any pathological changes internally, to account for death. This is a rare form of murder, except as it may be accidentally combined with exposure to cold. In order to convict the mother, it is necessary to show that the child was wilfully kept without food, with the criminal design of destroying it. Mere neglect or imprudence will not make the case infanticide, although it may be such as to justify a charge of manslaughter. The only appearance likely to be found on examination of the body would be complete emptiness of the alimentary canal. Without corroborative circumstantial evidence, this would not suffice to establish the cause of death: a medical witness could only form a probable conjecture on

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the point. In a suspected case of this kind, the contents of the stomach should be tested for farinaceous and other kinds of foods (*vide* "Live Birth," *ante*).

5. Intentional Immaturity.

From the case of *R.* v. *West* (Nottingham Lent Ass., 1848), it would appear that if by the perpetration of abortion, or the criminal inducement of premature labour, a child be born living at so early a period of uterine life that it dies merely from *immaturity*, the person causing the abortion, or leading to the premature birth, may be tried on a charge of murder. A midwife was alleged to have perpetrated abortion on a female who was between the fifth and sixth months of pregnancy. The child was born living, but died five hours after its birth. There was no violence offered to it; and its death appeared to be due entirely to its immaturity. The prisoner was acquitted, apparently on the ground that abortion might have arisen from other causes.

6. Violence by Wounds (External and Internal).

So long as breathing is taken to be the main token of life at birth, so long will violence inflicted upon a child at birth remain practically unpunished; but once it is admitted that circulation is as good a test, or perhaps better, of life, we are enabled to judge and decide decisively that violence was inflicted upon the child during *life*, though not "after birth."

The characters which have been already described in Vol. I., pp. 424 *et seq.*, as peculiar to wounds, contusions, and fractures inflicted during life, may be met with in a child whether it has breathed or died without breathing. So, again, these characters are open to the exceptions there pointed out; for they will be equally present, supposing the wounds to have been inflicted immediately after the cessation of respiration or circulation in the child, or after the cessation of circulation only, if the act of breathing has not been performed.

In general, when children are murdered, the amount of violence inflicted is considerably greater than that which is required to destroy them; whereby satisfactory proofs of the crime are occasionally obtained.

The questions that the medical jurist will have to answer in such cases are—

1. Were the wounds inflicted before or after birth?
2. Were the wounds inflicted before or after death?
3. If before, did they cause death?
4. Were they accidental or homicidal?

1. **Were they Inflicted Before or After Birth?**—In most cases it will be utterly impossible for a medical witness to return any answer to a question put in this form. All that medical evidence can pretend to show is, whether a child was living or not when the wounds were produced; for, whether the *whole* of its body was or was not in the world at this time, they will possess precisely the same characters.

In a few cases only, a conjectural opinion may be formed from the nature, extent, and situation of these injuries.

This question of before or after birth is really the whole crux of infanticide, and it may be stated once more that until the law is brought into line with the medical evidence of life before, at, or about birth, so long will verdicts of not guilty continue to be given.

2. **Were they Inflicted Before or After Death?**—Although marks of violence may establish that a child was either living or but recently dead at the time they were inflicted, they can never show that it was *born* alive. Injuries met with on the bodies of children alleged to have been born dead ought, however, to be of such a nature as to be readily explicable on the supposition of their having arisen from accident. If, from their nature, extent, or situation, they are such as to evince a wilful design to injure, it is a fair ground for a jury, and not for a medical witness, to inquire why these extensive wounds, or other marks of violence, were inflicted on a child, if, as it is alleged, it was really born dead. It must be confessed that in such a case there would be a strong moral presumption of murder, although medical proof of life or of live birth might totally fail.

As a summary of these remarks, it may be observed that, although physiologically a child may live for a certain period after its birth without breathing, and legally its destruction during this period would amount to murder, yet there are at present no satisfactory medical data to enable a witness to express a positive opinion on this point. If other evidence were adduced of a child having lived and been destroyed under these circumstances,—as where, for example, a woman causes herself to be delivered in a bath of water, or an accomplice covers the mouth of an infant in the act of birth, or immediately after it is born,—a medical witness would be justified in asserting that the absence of the signs of respiration in the lungs was no proof that the child had been born dead. Indeed, it is apparent that the process could not be established, owing to the criminal means actually employed to prevent it. In general, those cases in which questions relative to life before respiration might arise are stopped in the coroner's court,—the usual practice being, when the signs of respiration are absent or imperfect, to pronounce that the child was born *dead*. If the lungs sank in water, the presence of marks of violence on the body would be considered as furnishing no evidence; for the sinking of the lungs would be taken as positive evidence of stillbirth, an incorrect inference (*vide* p. 193 *et seq.*, the hydrostatic test).

The following case was the subject of a criminal charge at Havre:

A woman was delivered of twins. As soon as the first child was born, but not before it had breathed, she killed it by fracturing its skull with a wooden shoe. In a few minutes afterwards the second child was born; but scarcely had its head presented when she seized it and fractured its skull in a similar manner. This double crime was soon discovered. On an examination of the bodies of both children, the same degree of violence was found, presenting in each case precisely similar characters. There can be no doubt, from the appearance of the injuries, that they must have been inflicted on both children at a time when the circulation was going on. In one child, however, it was proved that respiration had taken place; in the other that it had not. In the latter case many practitioners would at once have affirmed that the child had not lived, because there was no proof that it had respired; and they would have proceeded to draw the inference that this could not have been a case of infanticide. Bellot, however, stated that, although the child had not breathed, he had no doubt it had been *born alive*, and that it would have lived to breathe but for the violence inflicted.

Apart from this ever-recurring quibble about breathing, it is as easy (or difficult) in a child as in an adult to say whether an injury was inflicted before or after death, and the question is decided on precisely similar lines (*vide* Vol. I., pp. 424 *et seq.*).

3. **If before Death, were they the Cause of Death?**—This point must be considered on precisely the same lines as in the case of wounds found on an adult (Vol. I., pp. 378 *et seq.*), but it must be remembered in drawing final conclusions that a frail infant may succumb to injuries which are comparatively slight. New-born children bear a loss of blood very badly.

A case of infanticide was tried (*R.* v. *Wood*, Buckingham Sum. Ass., 1840) in which the main question was, whether five severe wounds found on the head of a child were inflicted before or after death, and accidentally or criminally. The mother confessed that the child was born alive and had cried, but that it had died in five minutes after its birth. Its body was buried, and it was assumed that the wounds might have been accidentally inflicted after death with a spade which had been used for the burial.

The medical witness attributed death to the wounds, which, in his opinion, could not have been accidentally produced; but he admitted, in cross-examination, that the wounds would have presented the same appearances had they been inflicted immediately after death. Answers to questions of this kind can of course be given only in those cases in which the body has been examined soon after the infliction of the wounds. It would be extremely hazardous to pronounce an opinion when the child has been long dead.

4. **Were they the result of Labour, were they Accidental, or Homicidal?**—It is quite obvious that the answer to this question must depend upon (1) the nature, (2) the situation of the injuries. To exhaust the possibilities in either direction would require a complete monograph with very numerous illustrative cases, for in each case it is most requisite that in both respects the tale of the defendant be compared point for point with the details of the wounds, and each of these may vary indefinitely in details. The subject must, however, be looked at from its most salient points of view, and a few generalisations made.

(1) **Evidence from the Nature of the Wound.**—It is abundantly clear that nothing in the shape of a punctured wound, of a clean incised wound, of a burn, etc., could occur as the result of a natural labour, and if such are found they were certainly inflicted by someone, somehow, at some time during or after birth. It is possible to imagine that occasionally uterine force in a misplaced child could produce dislocation of a joint or even fracture of a limb, and it is well known and admitted (*vide* Williams' "Obstetrics") that a caput succedaneum and cephalhæmatoma are commonly produced by protracted labour, and that fractures of the skull (*vide* below) are now and again thus produced. It must be noted that we are here speaking of actual wounds, not of causes of death in protracted delivery (*vide* p. 237).

Incised Wounds found on the body of a new-born child may be referred to the use of a knife or scissors by the prisoner in attempting to sever the navel-string; and they may therefore be due to accident. This point should not be forgotten, for a wound even of a severe kind might be thus accidentally inflicted. In such cases we should always expect to find the navel-string *cut*, and not lacerated. The end of it should, for the purpose of examination into this point, be stretched out on a piece of white card.

In the case of *R.* v. *Wales* (C. C. C., September, 1839), it was proved that there was a wound on the right side of the neck of the child, not involving any important blood-vessels, although it had caused death. The medical witness allowed that it might have been accidentally inflicted in the manner suggested, and the prisoner was acquitted.

As this question may be unexpectedly put at a trial, a witness should prepare himself for it by a careful examination of the wound and of the navel-string. This will in general suffice to show whether an incised wound has been produced accidentally in the manner alleged, or by criminal design.

It is, of course, immaterial to inquire, and quite impossible to determine, whether such wounds have been inflicted while the child was being born, but if such is alleged they must be situated about the presenting part, head or buttocks commonly (*vide* below).

In the following case there could be no doubt from the nature of the wound that it had been inflicted with homicidal intent.

(*R.* v. *Hacking*, Lancaster Lent Ass., 1846.) A female who had attempted to conceal her pregnancy was charged with the murder of her infant child. It was ascertained that she had been delivered of a child, and the medical evidence was to the effect that its throat had been cut with some thin-bladed sharp instrument—*a portion of the gullet and windpipe having been cut away.* The prisoner stated that the child was born dead, and confessed that she had, as she believed, cut its throat with a penknife, which she had afterwards wiped and put away. The weapon was found in her pocket. The medical witness deposed that the child had certainly *breathed*, and he was inclined to think that it had been *born alive.* He admitted that a child might breathe when partially born, and die before it was wholly born; also that the appearance of the wound, whether inflicted before or immediately after death, would be similar; and it was impossible, from the examination, to say whether the child had been partially or wholly born at the time of its infliction. The prisoner contended that no evidence had been adduced which could satisfy the jury that the child had been *fully born alive*—a circumstance without which the charge must fall to the ground. The jury acquitted the prisoner (*Med. Gaz.*, vol. 37, p. 382).

In examining this case, it may be observed that such a wound with a penknife was hardly likely to be inflicted on the child by any accident, or for the purpose of aiding delivery. As the child had breathed, it is absurd to suppose that the woman waited until it had died from some other cause, of which there was no appearance; and that after death, without any conceivable motive, she had cut out a portion of its throat. So far as the report goes, the acquittal appears to have depended on the assumption that the child was destroyed before it was wholly born; and although it had breathed, there was a want of evidence to show that this breathing had continued after its body was entirely in the world.

Small punctured wounds of vital organs, brain, cord, heart, etc., should be most especially looked for by a most thorough autopsy.

The spinal marrow is said to have been wounded by needles or stilettoes introduced between the vertebræ, the skin having been drawn down before the wound was inflicted, in order to give to it a valvular character, and to render it seemingly superficial. The brain is also said to have been wounded, by similar weapons, through the nose or the thinner parts of the skull (the fontanelles).

A practitioner must remember that if, while in an advanced state of pregnancy, a female should **accidentally fall** the child may sustain an injury by a blow through the abdominal walls, and the fact is of sufficient importance to merit attention, as the following case will show :—

A pregnant woman, within five days of the ordinary term of gestation, fell while running, so that her abdomen struck sharply against an angular stone. There was an immediate loss of blood, and the movements of the child ceased. Parturition came on four days after the accident. Stanelli found the head of the child much enlarged, and in a putrid state. The woman died in an hour. On examining the child, the skull was found almost crushed, the parietal having become separated from the temporal bones as if by external violence. The marks of injury were entirely confined to the head (*Gaz. des Hop.*, November 7th, 1846, p. 523).

In injuries of this kind resulting from falls it is probable that the child will be born dead ; there may also be marks of violence on the abdomen of the woman. Some observers have described cases in which the limbs of the fœtus in utero have become deeply indented or spontaneously amputated by the twisting of the umbilical cord around them (*vide ante*, p. 242). A friend of the editor's was thus born with one arm amputated at the elbow. It is not possible, however, that these or other accidental injuries before birth could ever be taken for violence inflicted on the body of a child after its birth. A remarkable case of this kind was communicated to the *Med. Times and Gaz.*, 1853, 2, p. 604, in which a child was born without limbs.

Children are sometimes accidentally destroyed in the act of birth by the **neck being forcibly twisted,** whereby a displacement of the cervical vertebræ, with injury to the spinal marrow, may occur and destroy life. Such injuries are immediately discovered by an examination of the body. It should be remembered that the neck of a child is very short, and that it possesses considerable mobility.

Non-professional persons may, when a woman has been secretly delivered, ascribe the tumours known as **Caput succedaneum and Cephalhæmatoma** to violence, whereas they really are produced by natural causes. The swelling is generally situated on one of the parietal bones, its situation depending on that part of the body which presents during delivery. After the discharge of the waters, the scalp is firmly compressed by the mouth of the womb, and subsequently by the os externum. This pressure interferes with the circulation through the skin, and causes the compressed portion of the scalp to swell. In the simplest form of this tumour serum only is found in the swollen part ; occasionally this is mixed with blood, and there are small ecchymoses beneath or in the scalp and pericranium, or even within the skull, but there is generally no injury to the bones, nor is there any laceration of the skin externally. In other cases blood in some quantity is found effused in the tumour either under the scalp, the membrane covering the skull (pericranium), or within the skull itself.

Violence from blows or falls which would produce bloody effusions beneath the scalp, or within the skull, would in general be indicated by injury to the skin or by fracture of the bones. At the same time, the following case shows that caution is required in forming an opinion.

A child died twenty-three days after birth. The tumour (cephalhæmatoma) was about the size of a walnut originally, but it had extended so as nearly to cover the right parietal bone. On dissection it was found to be filled with coagulated blood, beneath which was a layer of dense fibrinous matter. The right parietal bone presented a fissure with clean edges running from the coronal suture obliquely backwards and upwards. On the inner surface of the bone was an effusion of blood between the cranium and dura mater more than half an inch in thickness, and occupying the whole of the hollow of the parietal bone. There was no reason to doubt that the fracture and effusion were the results of compression during delivery; they had not been occasioned by external violence ("Trans. of Med.-Chir. Soc.," vol. 28; see, for further information on this subject, "Churchill on the Diseases of Children," p. 66).

Vide also cephalhæmatoma in works on the surgical diseases of children.

Of course if a fracture is present (*vide* below) such a hæmorrhage is to be expected, but quite apart from this a **meningeal or even an intra-cerebral hæmorrhage** is a well-recognised consequence of difficult labour, and a well-recognised cause of many infantile palsies (*vide* Keating's "Cyclopædia of Children's Diseases," or other work on children). When such is found, then, in a dead child it must not be hastily assumed that it necessarily indicates violence; all other factors must be taken into consideration—length of labour, other marks suggestive of violence, etc.

Fractures of the Skull.—These may arise from uterine action, accident by fall, or criminal violence, and may be equally met with in violence to the living or recently dead body. On this question, as well as on accidental fractures of the skull during delivery, see a paper by Skrzeczka ("Ann. d'Hyg.," 1870, 1, p. 227; and also Williams' and other works on obstetrics).

Although it has been a matter of frequent observation that great violence may be done to the head of a child during parturition without necessarily giving rise to fracture, yet it is placed beyond all doubt that such an injury may occur by the expulsive efforts of the womb forcing the head of a child against the bones of the pelvis. Even the violent compression which the head sometimes experiences in passing the mouth of the uterus may suffice for the production of fracture.

These accidental fractures are generally slight: they commonly amount merely to fissures in the bones, beginning at the sutures, and extending downwards for about an inch or less into the body of the bone. The frontal and parietal bones are the only bones liable to be fissured or fractured during the act of parturition. In the greater number of cases reported, the parietal bones only have presented marks of fracture.

A history of these accidental injuries to the skull of a new-born child has been given by Schwörer ("Beiträge z. Lehre von dem Thatbetsande des Kindermordes," etc. Freiburg, 1836, p. 38).

In one instance he delivered a woman after a labour of twenty-seven hours. While the head of the child was at the outlet, the uterine contractions ceased for an hour; the child was then suddenly expelled, and Schwörer received it in his hands, so that its body did not come in contact with anything that could produce physical injury. The child did not breathe when born, but it showed evident signs of life. The pulsations of the heart and umbilical cord were distinctly perceived; these gradually ceased, and no effort could restore the child or bring about respiration.

The most important fact connected with the body was the condition of the head. There was a considerable swelling of the skin at the top of the head, chiefly over the right parietal bone, and beneath this a quantity of dark-coloured blood was effused. Two fissures or slight fractures were perceived in this bone—one passing from the sagittal suture towards the centre of the bone, about half an inch in length; and a second, about an inch long passing from the lambdoidal suture at the back part of the parietal bone, also towards the centre. There was no doubt that these fissures or fractures in the bone, with the effusion of blood beneath, were produced by the action of the uterus alone during delivery.

From these appearances, and in an absence of all knowledge of the facts, Schwörer considers that the following conclusions would have been drawn:—1st, that this child was born capable of living, and probably lived after its birth; and 2nd, that it had died a violent death from injuries inflicted on the head. A woman delivered of an illegitimate child in secret might, although innocent, have thus been compromised in a charge of murder (*op. cit.*, p. 44). As the lungs sank in water, entire and divided, it is highly probable that in this country the case would have been stopped by a coroner's jury, on medical evidence that the child was stillborn. Supposing, however, that further proceedings had been taken, the amount of violence to the head was comparatively too slight to justify a medical opinion that it absolutely indicated an act of murder. The bones were merely fissured, not dashed in nor displaced, and the brain was uninjured; the fissures were slight, and the amount of blood effused was very small for an act of homicidal violence involving the skull. Schwörer suggests that such cases should inspire caution in giving medical opinions; but medical men are prepared to make full allowance for the accidental occurrence of such injuries as these during labour.

Wharrie has published a case in which it is probable that a fracture of the head of a child was produced by the expulsive action of the uterus.

The body had been found secretly buried; it was fully developed, but the child had evidently not breathed. The navel-string had been cut and tied; but six inches of it still remained attached to the body. On the left side of the cranium, near the summit, there was a small effusion of blood; and on removing this, a fissure half an inch in length was found in the edge of the left parietal bone, close to the line of the sagittal suture, and near the posterior fontanelle. On shaving off the hair there was no discoloration, nor any mark on the skin indicative of a blow. There was no evidence to show that any violence had been used to the child at its birth, and from the description of the fissure it was a fair presumption that it had arisen from the muscular contractions of the uterus during delivery (Cormack's *Month. Jour.*, November, 1845, p. 847).

The possible occurrence of an accidental injury of this kind has been strained, in several cases of child murder, to explain the origin of fractures which, however, could not be fairly assigned to such a cause.

A case was tried at Glasgow in April, 1852 (*R.* v. *Irwin*), in which there was no doubt, from the state of the lungs, that the child had fully breathed, and there was violence to the head which satisfactorily accounted for its death. The whole extent of the right side of the head was deeply ecchymosed, and there was a large quantity of coagulated blood lying beneath the ecchymosis. In the centre of the right parietal bone there was a fracture extending across the vertex for fully four inches, and involving a part of the parietal bone on the opposite side; it was in a continuous even line, not radiated and not depressed. The pericranium, bones, and soft parts in the track of the fracture were deeply ecchymosed, while on the surface of the brain, particularly on the right side, there was a copious effusion of clotted blood. It was impossible to refer severe injuries of this kind to the action of the uterus in delivery, or to violence applied after death. The prisoner alleged that the child was stillborn (see *Edin. Month. Jour.*, June, 1825). In the case of *R.* v. *Mussett* (Bury Lent Ass., 1856) the head of a child was almost flattened from the violence sustained. It was clear that no fall or other accident could explain this condition. Some fresh blood and a single hair were found on a shelf in the cellar, for which the prisoner accounted by stating that she had there killed a rabbit. A microscopical examination, however, showed that it was human hair, and not the hair of a rabbit. The medical evidence established from the state of the lungs that the child had breathed, and that it had had an independent existence. The prisoner was convicted.

The reader will find an elaborate medico-legal paper on fractures of the skull in new-born children, by Casper, in his *Viertel-jahrsschr.* (1863, 1, p. 1), and by Wiebecke, in the same journal (1871, 1, p. 86).

The following case of spontaneous fracture of the left parietal bone occurred to Götz during a natural but tedious labour, in which the head of a child was five hours in the pelvic cavity, although the pelvis was well formed.

There were three fissures in the bones—one running into the sagittal suture, one to the inner inferior angle, and the other to the middle of the anterior edge of the bone. The child was stillborn. Much blood was effused beneath the scalp, but none under the skull (*Med. Gaz.*, vol. 39, p. 288).

In respect to these accidental fractures and effusions of blood from uterine action it may be remarked that they are in general recognised by their very slight extent. In cases of murder by violence to the head, the injuries are commonly much more severe; the bones are driven in, the brain protrudes, and the scalp is extensively lacerated. Such severe injuries as these cannot arise accidentally from the action of the uterus during parturition.

A case occurred in which, in addition to severe injuries to the brain, coal-dust and minute pebbles were found driven into the skin of the head by the body being thrown from a height (*Edin. Med. Jour.*, December, 1855, p. 492).

In these cases, however, it may be fairly urged that the woman was unexpectedly seized with labour, that the child was expelled suddenly by the violent contractions of the uterus, and that the injuries might have arisen from its head coming in contact with some hard surface—as a floor or pavement. A woman may be thus suddenly and unexpectedly delivered while in the erect posture, although this is not common among primiparous women, and several injuries may be thus accidentally produced on the head of a child.

A case of sudden delivery in the erect posture in a primiparous woman, without injury to the child, is reported by Ryan (*Lancet*, June 21st, 1845, p. 707). The umbilical cord was, in this instance, ruptured at the distance of about two inches from the navel. He also communicated to the author the particulars of a second case, which occurred in his practice in 1852. A woman who had borne a child was suddenly delivered while standing. The child fell to the floor on its vertex, and the cord was ruptured. A small quantity of blood escaped from the part struck, there was no fracture of the bones, and the child sustained no serious injury. In the case of another primiparous woman, sudden delivery took place while she was in the act of sitting down. The child was forcibly expelled, and fell with its head on the floor of the room; it was taken up dead, the cord being still attached to it, and the placenta, which came away shortly after the birth of the child (*Med. Gaz.*, vol. 37, p. 808).

It appears, from cases collected by Klein, that fractures of the skull even under these circumstances are of rare occurrence. Out of 183 cases reported by him, in which the women were rapidly delivered while sitting, standing, or inclined on the knees—the child falling on the ground or floor—there was only one instance in which a child was killed; and there was not a single instance in which the bones of the skull were fissured or fractured so far as could be ascertained by external examination. Chaussier performed some experiments on the bodies of stillborn children, allowing them to fall with their heads downwards on a paved floor, from a height of eighteen inches ; and he found that one or other of the parietal bones were fractured in twelve out of fifteen cases. Although these results are conflicting, yet Klein's observations appear more to the purpose; because they were made under circumstances in which the question would really arise in a case of infanticide. They are strikingly supported by the following cases:

Lancet, July 26th, 1845 :—A married woman was suddenly delivered while standing : the child fell to the floor, but sustained no injury ; the navel-string was ruptured close to the navel. A case analogous to these, also in a primipara, is reported (*Gaz. Méd.*, 26 June, 1847). A woman, æt. 27, was delivered of a child while in the act of walking to a hospital, at the distance of a mile. She stated that she had lost a large quantity of blood. The child, which she brought in her apron, was mature and living : the navel-string had been ruptured close to the abdomen (see also a case, *Med. Gaz.*, vol. 42, p. 371). Another instance has been reported (*Lancet*, 1853, 1, p. 245). A young married woman, æt. 23, pregnant of her first child, was delivered suddenly, while in the erect posture. The child, which was healthy and full-grown, fell upon the floor, and the cord was broken off within three inches of the navel : it was separated as cleanly as if it had been divided by an accoucheur. Excepting the production of a swelling on the forehead from a bruise, the child had sustained no injury by this sudden expulsion. A similar case occurred to Chevers ("Med. Jurispr. for India," 1856, p. 253). Coleman (*Lancet*, 1864, 2, p. 377) met with a case in which a married woman, while standing by the window of her bedroom, was suddenly delivered in his presence ; she had had no warning pains, and up to an hour of her delivery had been quite well. The child had fallen on the floor, but sustained no injury ; the navel-string was ruptured at one inch from the abdomen ; it was bleeding, but this was soon stopped by a ligature. The mother and child did well. Twitchell met with a case in which a young woman, æt. 17, was suddenly delivered while engaged in ironing. The child fell on the floor, rupturing the cord three inches from the umbilicus, but sustained no injury (*Lancet*, 1864, 2, p. 476). M. C., æt. 23, single, was suddenly delivered of a full-grown male child at 5.30 a.m. She stated that between 4 and 5 a.m. she felt griping pains. She suspected that her labour was coming on, and she walked to a friend's house at 600 yards' distance, to be confined. When she had proceeded halfway, she was suddenly delivered, while in the erect position, and her child fell upon the pavement. The navel-string was ruptured transversely four inches from the navel, and the placenta was expelled. She walked to the place where she intended to be confined, carrying the child, which she had wrapped in a petticoat. In about half an hour she was seen by a surgeon ; he found her in bed, looking perfectly well, free from pain, and merely complaining of cold. This was her first child : it was well nourished and healthy-looking. The only injury which it had sustained by the fall was on the left parietal bone, at the junction with the coronal suture ; there was here a soft tumour between two or three inches in its transverse diameter, which was slightly ecchymosed. Both mother and child did well, and the tumour entirely disappeared at the end of three weeks. The cord had been tied after the woman's arrival at the house (*Lancet*, 1864, 1, p. 637). For another case in which twins were suddenly born without any previous warning, see *Med. Times and Gaz.*, 1861, 1, p. 235.

These observations lead to the inference that fractures of the skull are not likely to occur, yet we cannot deny the *possibility* of their occurrence.

Swayne published (*Assoc. Jour.*, October 14th, 1853, p. 901) a case which shows that a fracture of the skull of a child may be produced when a woman is delivered in the erect position. In this instance there was merely the appearance of a bruise on the head, and the cord was ruptured (not cut) three inches from the navel. The child did not suffer from the fall, and continued well until six days after its birth, when it was seized with convulsions and died. A fissure of about an inch and a half in length was found in the upper part of the left parietal bone. A clot of blood was found in this situation between the dura mater and bone, and there was congestion of the vessels of the membranes; with this exception there was no morbid appearance in the body. Tenbern reported a case in which the child died from injury to the head by falling from the body of the mother in an unexpected delivery (Horn's *Vierteljahrsschr.*, 1870, 1, p. 113). The cause of death was effusion of blood on the brain; and in this case there was no fracture or fissure of the bones of the skull. In another case there was sudden delivery in the erect posture, the child falling with its head on a deal floor. A large fissure was found in the right parietal bone, and there was a great effusion of blood, which had caused the death of the child. There was no reason to doubt the woman's story (Horn's *Vierteljahrsschr.*, 1866, 1, p. 165; 1871, 2, p. 26). In this, as in some other cases of delivery in the erect posture, the umbilical cord was torn through at about two and a half inches from the body.

Porter Smith communicated to the author a case in which the facts were similar to those above related. In consequence of the concealment of the body, however, the mother was charged with the murder. The right parietal bone was fractured, and there was effusion of blood internally, but there was no mark of external violence. The cord had been ruptured at a distance of two and a half inches from the navel. The stomach of the child contained the usual albuminous and mucous matters of the fœtal state, without any appearance of food. The lungs were inflated and highly crepitant; the foramen ovale and the ductus arteriosus were in their fœtal condition. The child had probably been drowned in the discharges from want of assistance at the time of birth. The woman, who admitted that the child fell from her suddenly, was acquitted. Olshausen has published four cases of sudden delivery, in each of which the child dropped from the woman, and in two of them there were fissures in the parietal bones. The children recovered from the effects of the accidents (*Med. Times and Gaz.*, 1860, 2, p. 219; *Amer. Jour. Med. Sc.*, January, 1861, p. 279). Other cases of rapid delivery in the erect posture are reported (*Lancet*, 1861, 1, p. 13). In these there was no injury to the child, although in one case the delivery took place on the deck of a vessel.

Braxton Hicks has called attention to the possibility of fractures or fissures of the bones of the head being caused by **lateral pressure of the skull from the hands of the mother in order to aid her delivery.** It would appear, however, from his experiments on this subject that such injuries may as a rule be distinguished from those which are the result of a deliberate attempt at murder (Guy's Hosp. Rep., 1866, p. 473).

A woman in self-delivery can only resort to *pressure* or to the attachment of cords, etc. (*vide* "Strangulation or Cutting Instruments," *ante*). Hicks performed various experiments on the heads of stillborn infants.

In one instance by sudden lateral pressure he produced a fracture through the arch of the cranium, but the bones generally yielded to the force without breaking, When, however, one side of the head was laid on a hard and resisting surface like the floor, and the other side was compressed firmly and suddenly, a fracture was produced in the parietal bone to the centre, although the bones of the head were firmly ossified. In two other experiments on large children with firmly ossified skulls, lateral pressure with both hands, one on each side, caused no fracture or injury such as could be mistaken for homicidal violence. There was a fissure of about half an inch in the left parietal bone, produced not so much by pressure as by an indentation of the bone. The appearances produced by pressure on the head of a stillborn child, after a severe labour, were as follows:—there was a large bloody scalp-tumour over the right parietal and occipital bones; liquid blood oozed out on section; and the veins on the inside of the skull were highly congested, especially on the part beneath the scalp-tumour.

The fissure produced on the parietal bone was, however, too slight to be consistent with the theory of homicidal violence (see a paper by Casper, *Vierteljahrsschr.*, 1863, 1, p. 20). It follows, from these experiments on the dead bodies of new-born children, that fractures of the skull are not easily produced under the conditions in which a woman would be placed in delivering herself. The bones, as in natural delivery, yield to great pressure without breaking. Their composition and elasticity, as well as the yielding of the parts in the situation of the sutures, tend to counteract the effects of manual violence thus applied to the head.

When the marks of violence found on the head, neck, or body of a child cannot be easily referred to an accidental fall, it is common to ascribe them to the **efforts made by a woman in her attempts to deliver herself**, the destruction of the child being an accidental result of these efforts. A medical opinion in such cases must depend upon the nature, situation, and extent of the injuries; and each must be therefore decided by the circumstances attending it.

On these occasions a witness will often find himself questioned respecting the strength or capability for exertion evinced by the lower class of women shortly after childbirth. Alison remarks that many medical practitioners, judging only from what they have observed among the middle or higher ranks, are liable to be led into an erroneous opinion, which may affect their evidence.

He mentions a case in which a woman accused of child murder walked a distance of twenty-eight miles in a single day, with her child on her back, two or three days after her delivery (case of Anderson, Aberdeen Spring Circ., 1829). Instances have even occurred in which women have walked six and eight miles, on the very day of their delivery, without sensible inconvenience ("Criminal Law," p. 161). In one case (Smith, Ayr Spring Circ., 1824) the woman was engaged in reaping—she retired to a little distance, effected her delivery by herself, and went on with her work for the remainder of the day, appearing only a little paler and thinner than usual. In the case of Macdougal (Aberdeen Spring Circ., 1823), the prisoner, who was sleeping in bed with two servants, rose, was delivered, and returned to bed without either of them being conscious of what had occurred. Cases like the last have often presented themselves in the English courts.

A firm resolution, with a strong desire to conceal her shame, may enable a woman to perform, immediately after her delivery, acts connected with the disposal of the body of her child, which, from ordinary experience, might appear to be much beyond her strength.

In *R.* v. *May* (Court of Exch., May, 1857), for concealment of birth, it was proved that the prisoner, a domestic servant, had been sent to market with some poultry. On her return, she asked the boy who drove the cart to stop. He did so: she got out and went to a recess in the hedge by the side of the road, and in five minutes she was observed following the cart, and she walked home a distance of a mile and a half. She went about her usual work on that and the following day. She had been delivered of a child in the recess, and it was subsequently found there. One witness heard it cry, but it soon died.

Vide also pp. 69 and 70 for further references.

A witness, however, should be prepared to allow that a woman at the time of her delivery, owing to pain and anxiety, may be deprived of all judgment, and may destroy her offspring without being conscious of what she is doing. It is a principle of law that mere appearances of violence on a child's body are not *per se* sufficient, unless there is some evidence to show that the violence was knowingly and intentionally inflicted, or the appearances are of such a kind as of themselves to indicate intentional murder (Alison).

When the skull of a new-born infant is found to be fractured, the question put to a medical witness may be—Is the degree of injury such as to be consistent with the view that it was accidentally caused during delivery, either by the woman herself, or by some person who was present? Braxton Hicks was called by a midwife to aid the delivery of a woman. On examination, he observed that—

The skull was fractured through the parietal bone on one side, and there was a slight fracture of the edge of the occipital bone, with a scalp-tumour. The head of the child was at the brim of the pelvis, and the fractures had been produced by the midwife in her attempts to push the head back into the cavity. The woman was delivered by instruments: in such a case a woman would not be able to deliver herself. In another instance a new-born child had a fracture through the arch of the skull, from one side to the other, and a fracture in the frontal bone on one side. The jaw was broken, the angle of the mouth lacerated, and the arm-bone (humerus) was also fractured. The woman who had been delivered of the child was charged before a magistrate with wilful murder; and the question was, Had she, in attempts to aid delivery, produced this violence on the body by seizing the head and violently compressing it, or had the injuries resulted from the body falling on the floor of the room? Conflicting medical opinions were given, but Hicks, who was called as a skilled expert, admitted that the injuries might have been possibly inflicted by the prisoner on the child in her attempts at self-delivery.

Evidence from the Locality.—If many incised wounds are found about the limbs or body of a child, infliction by a second person, and that not by accident, is again an inevitable deduction. In some instances the body of a child is found cut to pieces, and the allegation in defence may be that the child was still-born, and the body had been thus treated merely for the purpose of concealment.

Toulmouche has reported a case of this kind. As the woman had not destroyed the lungs, experiments on these organs gave satisfactory results of perfect respiration. The cavities of the heart and great vessels were empty: the body was generally drained of blood, and the skin throughout very pale. This led to the inference that the mutilations most have been inflicted while the child was living; and as all the parts were healthy, and no natural cause of death was apparent, Toulmouche ascribed the death of the child to the wounds. The woman was convicted ("Ann. d'Hyg.," 1853, 2, p. 200).

In this country she would probably have escaped under a verdict of "Concealment of birth."

If marks of violence, apparently inflicted about the same time, are found on **different and remote parts of the body**, and these marks bear the characters of those produced during life, it is rendered probable that they were inflicted criminally upon a child that was completely born. Marks of severe violence on one part, as the head or breech, would not always justify such a presumption, because it might be fairly objected that they had been unintentionally produced by the woman in her attempts at self-delivery, and yet the child not have been born alive. It would be for a witness to form an opinion from the circumstances accompanying the particular case, whether they had been thus occasioned.

A child which was said to have been born dead, was exhumed two days after burial and eleven days after birth. It was full-grown, not putrefied, and the skin was pale and free from lividity. There was a clean cut on the right arm, dividing the fascia and muscles, as if made by a sharp instrument. The edges were much retracted, and the whole of the wound was of a florid red colour; but there was no swelling nor appearance of inflammation. There was a large vesicle (like the blister of a burn) on the scrotum, containing three drachms of a yellow coloured serum. On the right leg, the muscles were exposed for nearly the whole length: the surface of the wound was of a deep scarlet colour, and the margin widely inflamed. It had the appearance as if fire had been applied to the leg, although there was no sign of charring. These facts tended to show that the child was living when the injuries were inflicted; while the nature and situation of the injuries rendered it impossible that they could have arisen from any accident during delivery. The state of the lungs was somewhat remarkable: the *left* floated freely on water, and there was distinct crepitation in it; the right sank in water, no portion of it, when divided, was observed to float. From the buoyant and crepitant state of the left lung, there was reason to presume that if respiration had commenced during birth, it had continued afterwards. Prince, therefore, inferred that the child had been born alive: this inference was corroborated by the appearance of the marks of violence. It is probable that the child did not live long after birth.

The air could not have been derived from putrefaction nor artificial inflation: therefore the only question here was, whether the child had breathed after its body was wholly in the world. The facts above mentioned justified the inference drawn. From a confession subsequently made by the mother, it appeared that the child had been born alive, and had cried, but, owing to the injuries inflicted on it, it did not survive birth longer than a quarter of an hour.

It is, however, to the **head and neck** that injury arises most frequently both in Nature's efforts at expulsion and in a woman's frantic efforts at self-help. It is consequently in this locality that we meet with the greatest difficulty, firstly in deciding whether the injury was inflicted by nature or accident without the intervention of a second person; and secondly in deciding whether the obvious intervention of the woman was criminal or otherwise.

A medical witness would find no difficulty in determining the probability of an explanation of the origin of fractures of the neck and head, etc., if he were made acquainted with all the facts connected with the delivery. But it will, in general, be out of his power to obtain this knowledge. Sometimes the fractures will be accompanied by incisions, punctures, or lacerations of the scalp or face: in such cases, although the origin of the fractures might be accounted for by an alleged fall during parturition, the cause of the other injuries would still remain to be explained. Injuries of this nature, with the fact that there are bruises or contusions as well as fractures not connected with each other in various parts of the skull, and depending on different acts of violence, would be inexplicable on the hypothesis of an accidental fall.

A girl was delivered in secrecy. She at first denied that she had had a child, but afterwards produced the dead body. It was mature and had breathed. There were some marks as of pressure about the neck, and extensive effusions of blood beneath the scalp in various parts of the head. There was no fracture, but a fissure in one of the bones of the head. She said she had been suddenly delivered while standing up, and found that the child had fallen from her and was dead. Casper considered that this would not explain the condition of the head, which presented the effects, not of one, but of several distinct acts of violence, and the death of the child was referred to the injuries found on the head. The girl afterwards confessed that she was delivered while lying on the bed, and that she had then struck the child on the head and body with a wooden shoe (Horn's *Vierteljahrsschr.*, 1870, 2, p. 204).

An inquest was held in February, 1854, on the body of a female infant, of which a young woman had been delivered on December 21st, 1853. The infant had been born, according the statement of the mother, in the pan of a water-closet on the ground-floor of the house, and was afterwards carried by her up two pairs of stairs, and placed beside her in bed. She admitted that the child had been born alive, but stated that it was dead when she lifted it up from the pan to carry it to the bedroom. The navel-string was torn at a distance of four inches from the abdomen. The child, she alleged, had fallen into the watercloset pan. No trace, however, of blood or other discharge was found on nor near the seat of the closet; while upon the opposite side of the chamber the floor was stained with blood, which had been imperfectly wiped up. On an examination of the body of the infant, it was found to be a well-formed mature child, weighing seven pounds. The lungs had been fully expanded, covered the heart, and floated on water with or without the latter organ. The scalp presented no trace of injury; there was only the usual scalp-tumour, and on dividing the skin there was some ecchymosis at this part. The bones of the skull were extensively fractured. There was a horizontal fracture nearly an inch long over each orbital prominence; and upon the right frontal eminence the bone was broken and depressed, in an acute triangular form, three-quarters of an inch in length. The parietal bones on each side were fractured vertically from their eminences downwards, to the extent of an inch and a quarter; and on the left side the lower end of this fissure was joined by another of similar extent, passing horizontally forwards at a right angle to the edge of the bone. Similar smaller fractures were found at different parts of the upper surface of the skull, apparently not connected with each other. Within the cranium, blood was extravasated on the surface of the brain, and in the membranes. No fractures were detected at the base of the skull. The mother alleged that the injuries to the head were owing to the child having fallen into the pan of the closet. This explanation, however, was inadmissible, as it was very doubtful whether the body of the child had been in the pan at all. Even supposing the child to have thus fallen, the distance was too small to have caused such an amount of injury situated on various parts of the skull; besides which, as the child would have passed in an oblique direction forwards from the outlet, it would probably have glided safely down by the side of the pan. In the absence of evidence as to the mode in which the injuries were inflicted, it was suggested that they might have been caused by the mother having fallen upon the child on her way upstairs; and this hypothesis was ultimately adopted by the coroner's jury, though there was no doubt that the child's death was caused by the injuries to the head (see another case in *Med. Times and Gaz.*, 1857, 1, p. 347).

In *R.* v. *Gibson* (Gloucester Ass., 1864), the evidence was to the effect that the skull of the child was fractured, and much blood was effused on the brain. The right lung contained air, and the left lung also, but in smaller quantity: they both floated in water. The prisoner admitted that the child cried twice, and accounted for the fracture of the skull by asserting that the child had dropped from her in a lane. She wrapped it up, and soon afterwards found that it was dead. A stone having blood and hair upon it was picked up near the body. The prisoner was acquitted. In *R.* v. *Strangeways* (C. C. C., December, 1864), there was not only a fracture of the right parietal bone, but the throat was cut, and, according to the medical evidence, with a knife. From the state of the lungs it was evident that the child had breathed, but the medical witness declined to say that it had had an existence independently of the mother. The defence here was, that the child had dropped from her while she was standing at her work, and that it fell on the kitchen fender. There were, however, no marks of blood on the fender, and the wound in the throat was inconsistent with such a statement.

Severe fractures with great depression of the bones, and the co-existence of lacerated **wounds of the scalp with severe injuries on other parts of the body,** are not consistent with the theory of their production in self-delivery. Nevertheless, as in the following case (*R.* v. *Sheppard,* Winchester Wint. Ass., 1863), such violence even when plainly homicidal may, under the present state of the law, be treated as accidental.

The medical evidence showed that the new-born child had breathed, and there was no apparent natural cause for death. There were marks of finger-nails on the neck, *evidently indicating attempted strangulation.* The bones on each side of the head were crushed *inwards;* there was much blood effused between the dura mater and the skull, and this had caused pressure on the brain. A fall from a standing labour, or accidental force applied during delivery, could not have produced these appearances. They were caused, in the opinion of two medical witnesses, by the direct application of violence to the head of the child, and more than one blow must have been given to have produced them.

In charging the jury upon the cause of death, the judge said:—"The medical men had attributed it to the combined effect of strangulation and violence to the head. It might, however, be a theory that the struggles of a young woman during parturition might have occasioned the injuries, or she might in her weakness have fallen upon the child while on the floor. Did the medical evidence satisfy them beyond a reasonable doubt that this young woman had murdered her child?" The jury returned a verdict of Not Guilty. It is obvious from this and other cases of a similar kind, that there is scarcely any amount of violence affecting the head of a new-born child which will not be theoretically assigned to the act of a woman in self-delivery.

It is important in cases such as these that the medical man should examine the thighs and vulva of the mother for similar evidence of wounds, scratches, etc.; it is inconceivable that a woman should in efforts at self-delivery inflict *severe* wounds on the child, especially with an instrument of any kind, scissors, knives, etc., without at the same time doing some damage to herself. To excuse severe injuries on the child necessitates the assumption of a condition of frenzy on the part of the mother, and in a frenzy she would probably damage herself. The finding of such lesions on her would strengthen the defence materially.

The following form of violence is very rare (C. C. C., March 10th, 1898, *R.* v. *Cohen*). An inquest was held by Wynne Baxter in January and February, 1898, on the new-born child, the daughter of an unmarried woman, who admitted to the police, "Yes, I **threw the baby out of the window.**" That the child was thrown out of an upstair window there was abundant evidence to show, and also that the mother was alone in her confinement.

Dr. Oliver's evidence was as follows:—On the 23rd January, I was called to the Commercial Street Police Station. I was shown the body of a newly-born female child. It was alive. It was well developed but expired shortly after my arrival. It had received no skilled attention at birth being still covered with sebaceous material. The cord had been torn four and a half inches from its insertion into the child. It had not been tied. The blood was still moist at the severed end. Frothy blood issued from the mouth and nose. Examination shewed left thigh was broken at its middle. There was a protrusion of the brain substance and a large quantity of blood from the skull. This had escaped through a rent made in the scalp. *Lungs* were sufficiently inflated to nearly fill the chest cavity. They floated in water with and without the heart. *Heart* and other organs were normal, and had escaped damage. The cause of death was shock, following fracture of the skull and thigh. Verdict: Guilty of the act, but not responsible on account of her mental condition.

7. POISONING.

This is placed among the possible means of perpetrating child-murder, but we rarely hear of *new-born* children being thus destroyed. The earliest age at which the author knew a trial to take place for the murder of a child by poison was two months (*R.* v. *South,* Norfolk Aut. Circ., 1834). Arsenic was given to an infant, and it died in three hours and a quarter after the administration of the poison. If, in a case of child-murder, death from poison should be suspected, the poison must be sought for. Some cases have occurred, in which children have been wilfully destroyed a week or two after birth, by the administration of opium (*Practitioner,* May, 1882), or excessive doses of purgative medicine. A woman was sentenced to eight years' imprisonment for the crime of poisoning her new-born child with concentrated sulphuric acid. In another case a woman was convicted of poisoning her infant with phosphorus scraped from lucifer matches ("Ann. d'Hyg.," 1869, 2. p. 124). In some instances, the poison has been found on the napkins used for the child (*R.* v. *North,* Guildford Sum. Ass., 1846). Sir Thomas Stevenson has met with an instance of the death of an infant in 1883, by the administration of chloride of antimony (*R.* v. *Wallis, vide* "Poisoning by Antimony").

In cases in which infants are destroyed by poison there is generally great difficulty in tracing the act of administration to the guilty person. The fluid food given to them renders the admixture of poison easy, and as many persons may have access to this food, it is often impossible to fix upon the criminal.

In one instance, an illegitimate child had been placed out to nurse by its mother. It was noticed that after each visit paid by the mother the child was sick, and after repeated attacks of illness the child died. On inspection, arsenic was found in the body, and this was beyond doubt the cause of death. There was no suspicion against the nurse; but a strong suspicion fell on the mother, from the circumstances above mentioned. There was evidence, however, that the child was not at any time fed by the mother when she visited it, and that the mother had no access to the child's food. No poison could be traced to her possession, and she was not seen by the nurse, who was present, to give anything to the infant. The only fact that transpired was that, at each visit, she took it in her arms, and was observed to rub its gums with her finger, and soon after her visit, sickness followed. There was reason to believe that she had concealed small quantities of arsenic under her finger-nails, and that she had thus administered the poison while rubbing the gums of the child.

The editor is not able to find any fresh case. He would remark that if such a case were to crop up the medical witness would not have the same difficulty in his evidence that he has in strangulation and wounds. It is absolutely out of the question to assume that poison given to the child could help the mother's labour; it is equally out of the question to imagine that poison would (? could) be given to a child before it was completely born; and lastly, it could hardly arise accidentally (unless the child were born on to a bag of vermin killer, etc., of which there would be evidence). The only difficulty of a genuine character is that of establishing the fact of poison being the cause of death (*vide* Sect. XVI.).

8. Drowning and Suffocation.

The fact of drowning cannot be verified by any appearances in the body of a child which has not breathed. Thus, if a woman caused herself to be delivered in a bath, and the child was forcibly retained under water (a case which is said to have occurred), it would of course die; but no evidence of the mode of death would be found in the body. For cases in which a child was thus destroyed, probably, however, through accidental circumstances, see *Dub. Med. Press*, March 4th, 1864, p. 135. After respiration, the signs of drowning will be the same as those met with in the adult (see Vol. I., pp. 654 *et seq.*). The main question for a witness to decide will be, whether the child was put into the water, or the vessel containing water, living or dead. Infanticide by drowning is by no means common; the child is generally suffocated, strangled, or destroyed in other ways, and its body is then thrown into water in order to conceal the real manner of its death. The discovery of the dead body of an infant in water must not allow a witness to be thrown off his guard, although a verdict of "found drowned" is so commonly returned in these cases. The body should be carefully inspected, in order to determine what was really the cause of death. All marks of violence on the bodies of children that have died by drowning should be such as to have resulted from accidental causes. The throat and air-passages should be particularly examined.

In a case which occurred to Schraube it was clear, from the state of the lungs, that the child had breathed, but no water was found in the lungs or stomach. There was a furrow or depression around the neck, such as would be produced by the pressure of a ligature. The conclusion arrived at was that this child had been strangled and its body thrown into water after death (Horn's *Vierteljahrsschr.*, 1867, 1, p. 302). The reporter gave his opinion from the facts that the child had lived, chiefly owing to the state of the lungs.

It is not necessary that the *whole* of the body of a child should be submerged in order that it may be destroyed by drowning: the mere immersion of the head in water, or the covering of the mouth with liquid, will suffice to produce the usual effects of asphyxia. **The air-passages should therefore be examined for foreign substances** which may be deposited in them. A woman attempted to destroy her child by immersing its head only in a bucket of water. The child was discovered and resuscitated. This mode of destroying children by drowning may easily deceive a medical man. He would commonly look for evidence of the submersion of the whole body, and if no pond or well were near, he might, from the absence of well-marked post-mortem appearances, assign death to some natural cause.

Lankester mentions the case of a woman who drowned her child, but who was acquitted at her trial on the ground that no water had been seen in the room; yet there were witnesses in court who had sworn before the coroner's jury that water was in a pail in the room, and was taken away after the death of the child.

New-born children may be drowned or suffocated by being thrown into liquid mud or into the soil of a privy. Sometimes the child is destroyed by other means, and its dead body is thus disposed of for the purpose of concealment. Should there be a large quantity of liquid present, the phenomena are those of drowning. The liquid portion of the soil abounding in sulphide of ammonium may be found, if the child was thrown in living, in the air-passages, gullet or stomach. The mere discovery of soil in the mouth would not suffice to show that the child was living when immersed. The presence of foreign substances, such as dirt, straw, or ashes, in the air-passages, gullet, and stomach, must be taken as a proof of the child having been living when immersed in the dirt, etc., and that the substances have been drawn into the passages by inspiration or the act of swallowing.

In *R.* v. *Allridge* (Derby Wint. Ass., 1859), the dead body of a child was found buried in a garden. On examination there was earth in the mouth and throat, as well as in both nostrils at the back part; and particles of earth were found in the windpipe and air-tubes, as well as in the stomach. The medical witness referred the death to suffocation, and considered that the earth must have been inhaled. Another medical witness, for the defence, affirmed that the earth might have been carried into the passages of the body accidentally by the percolation of water (in eight days), and that it had not found its way there by inhalation. The jury upon this acquitted the prisoner Although the mouth and throat may thus accidentally receive foreign matters, it is most improbable that earth should be carried into the air-tubes or stomach by rain-water. The child was probably thrust into the earth when it retained some power of breathing and swallowing, and the earth found in the mouth and throat might be assigned to the violence with which it was forced into the soil. The nature of the soil, and the circumstances under which the dead body is found, must materially guide a medical opinion in cases of this nature.

On these occasions, the defence may be :—1. That the child was born dead, and that the body was thrown in for concealment; but the evidence may show that the child had breathed, and had probably been born living. 2. It may be alleged that the child breathed for a few moments after birth, but then died, and that the female thus attempted to conceal the body. A witness may here be asked, whether a woman could have had power to convey the body to the place—a point which must, as a general rule, be conceded. 3. It is most commonly urged that the woman, being compelled to go to the privy, was there *delivered unconsciously* or unexpectedly; that her waters had broken, and that she had no idea of anything more having happened; or that the child had dropped from her, and was either suffocated or prevented from breathing (*Med. Times and Gaz.*, 1861, 2, p. 646). All these circumstances may readily occur, but, on the other hand, the explanation may be inconsistent with some of the facts.

The evidence of drowning is the same practically in a new-born infant as in the case of an adult, but it is infinitely more common in the former class to have the body thrown into the water after death. The stronger the evidence of actual death from drowning (*vide* Vol. I., p. 654 *et seq.*), if the vessel in which the child is drowned is a little way out of reach, the stronger the presumption in favour of a separate existence, because the child must have been carried to the vessel. But this only holds if the foreign material found in the air passage be not blood, urine, or liquor amnii. If these be found, the presumption runs strongly the other way. Mummification of the cord in the body of a child found genuinely drowned (*vide* p. 223) is practically conclusive proof of a separate existence.

Reference may be made to Vol. I., where homicidal drowning is considered, especially as regards the particular place where the drowning took place.

9. Deliberate Neglect to Tie the Cord.

As far as **intent not to tie** goes it is of course impossible for medical evidence to establish it, though it may be suspected; but it is important, after noting the method of severance (*vide* p. 225) to ask *why* was it, not tied. Ignorance of the necessity for such a procedure may be pleaded, and will be a defence not easily upset, for it is not to be supposed that an ignorant woman has any intuitive knowledge of such necessity.

10. Burning.

If a practically complete body of a child be produced with burns upon it, the same questions will arise as in the case of adults, especially "Before or after death?" and "Were they the cause of death?" (*vide* Vol. I., pp. 586 *et seq.*). If the evidence clearly establishes that they were "before death," then homicide becomes certain, because a fire can never be so near to a mother's vulva that the child's body could be burnt in the act of parturition. Hence, with burns there is not so much difficulty in deciding upon criminality as in some other forms of violent death.

If merely calcined remains of bones, etc., are laid before a medical jurist, his evidence beyond mere identification of human remains (*vide* Vol. I., pp. 214 *et seq.*) is destroyed, and it is well he should at once admit the fact.

The following is a case in point:—

At Wiltshire Assizes, June, 1904, before Mr. Justice Ridley, Maud Webb, charwoman, of Trowbridge, was indicted for the wilful murder of her newly-born child on March 22nd. The charred bones of the child were found in the grate of the cottage occupied by prisoner, and there was evidence that the fire had been started by means of paraffin oil, which a midwife purchased for the girl while her child was still alive. The defence was that the child was choked by natural causes, and that prisoner disposed of the body by burning it because she had no money to meet the burial expenses. The jury acquitted the accused.

SUMMARY OF BIRTH, LIVE BIRTH, AND INFANTICIDE.

Owing to the very numerous and intricate nature of the points in connection with these subjects, and also to their importance, it seems worth while to compile and draw attention to a set of conclusions on the matter for brief reference.

1. An unborn child has rights specified by law.
2. Birth must be defined as completely external to the mother.
3. The evidence of live birth is divisible into two broad classes:

(*a*) those which leave no possible marks behind them, discoverable by autopsy; (*b*) those which may leave, and in general do leave, evidence so discoverable.

4. To prove the presence of a member of class (*a*), which is of supreme importance in civil cases, it is absolutely essential that an eye-witness present at the birth should give evidence, and such eye-witness ought to be either a medical man or a person or persons not interested in the result of the case. By no other possible means can it be determined that members of this class did or did not exist after birth.

5. In civil cases, unless the child lives long enough to produce some of the members of class (*b*), then in the absence of eye-witnesses no medical evidence can be given at all, and if the case is to be decided it must be decided by evidence other than medical.

6. In cases of alleged child murder where there has been evidence from eye-witnesses that the new-born child was living when violence was offered to it, or that the child was found soon after delivery, still alive, medical proofs of such children having lived at their birth are not required.

7. In all criminal cases the whole case depends upon this particular point: "Was the child maltreated after it was *born* alive?" Notice that it is not "Was the child maltreated while it was alive?" the two points are as different as they well can be. It is comparatively easy to answer the latter; it may be broadly put that it is impossible to answer the former unless under some special circumstances.

Fifty odd years ago, in *R.* v. *Burns*, C. C. C., March, 1863, the judge made the following remarks, in addressing the jury:—"Before finding the prisoner guilty, they must be satisfied that the child was completely born into the world, and had had an existence independently of the mother. If they were not convinced of this, there would be an end of the inquiry, because a child not completely born could not be made the subject of an indictment for murder. Again, supposing the child to have been fully born alive, they would then have to consider whether its death had resulted from any deliberate and wilful act on the part of the mother."

This view has not been materially altered since it was expressed (*cf.* Wright, J.'s, definition, p. 190), and just as stringent proofs of life after birth are now required as formerly.

8. Between the different members of class (*a*) there is nothing to choose, movements of limbs, mouth, eyelids, etc., slight cry, pulsations in the cord, are all of equal value.

9. In class (*b*) punctured wounds, drowning (in liquid other than urine, fæces, liquor amnii, and blood), burning, and food in the stomach offer the best opportunity of proof of live birth; respiratory changes and wounds about the head and neck are practically worthless.

SUB-SECTION K.—UNNATURAL OFFENCES.

Decency suggests that these should be left unnoticed, but the claims of legal medicine necessitate a brief reference to them. The actual offences themselves which will be noticed are :—

Masturbation or onanism.
Indecent exposure.
Sodomy.
Tribadism.
Bestiality.

On the first of these the law is silent unless done publicly, and so it is on tribadism, but the others are criminal offences.

The actual statutes dealing with such offences are few in number. 24 & 25 Vict. c. 100, ss. 61 and 62 run as follows :—

"61. *Whosoever shall be convicted of the abominable crime of buggery, committed either with mankind or with any animal, shall be liable, at the discretion of the court, to be kept in penal servitude for life or for any term not less than ten years.*

"62. *Whosoever shall attempt to commit the said abominable crime, or shall be guilty of any assault with intent to commit the same, or of any indecent assault upon any male person, shall be guilty of a misdemeanor, and being convicted thereof shall be liable, at the discretion of the court, to be kept in penal servitude for any term not exceeding ten years and not less than three years, or to be imprisoned for any term not exceeding two years, with or without hard labour.*"

And 48 & 49 Vict. c. 69, s. 11 runs as follows :—

"11. *Any male person who, in public or private, commits, or is a party to the commission of, or procures or attempts to procure the commission by any male person of, any act of gross indecency with another male person, shall be guilty of a misdemeanor, and being convicted thereof shall be liable at the discretion of the court to imprisonment for a term not exceeding two years.*"

Masturbation.—Readers of Krafft Ebbing's "Psycopathia Sexualis" will not need to be informed how the practice of this "crime against self" may easily lead to crime against others. So long as the act is not done openly the law cannot take notice of it, though medical men are well aware of its terribly evil effects. Presumably gross indecency would only include the act done *coram publico* with probable exposure of the person, though it might be made to include a great deal more. When such cases occur they seldom (and rightly perhaps) receive notice in the public prints, and the editor is unable to find any cases in point. Medical evidence could only go so far as to prove the emission of semen (*vide* Vol. I., "Tests for Semen"); but unless caught *flagrante delicto* it is not likely that any person would be brought to trial.

Indecent Exposure.—This is covered by the same section as the above. It is very strange that the law should have confined the offence to persons of the male sex only, for there are plenty of women so depraved that they could easily be capable of committing the offence.

Medical evidence could, of course, throw no light on the actual perpetration of the offence, but it is almost always required to throw light on the mental condition of those who have perpetrated it, who are almost invariably found to be lunatics (*vide* "Lunacy").

R. v. *Jones and Bowerbank*, [1896] 1 Q. B. 4.—Prisoner procured the commission of an act of gross indecency with the prisoner himself. Held: Offence was complete.

Husband or wife of person so charged may be called as witness (Crim. Evid. Act, 1898, s. 4).

Sodomy or Buggery should be defined as the action of a person of the male sex attempting to obtain sexual gratification by means of the anus of another human being, but it is also apparently used to include the same act when an animal is used, whether per vaginam or per anum; this latter case we shall refer to as bestiality (*vide infra*).

The evidence required to establish it is the same as in rape, with two important exceptions. The 1st *exception* is, it is not necessary to prove the offence to have been committed against the consent of the person upon whom it has been perpetrated; and, 2nd, both agent and patient (if consenting) are equally guilty; but the guilty associate is a competent witness. In one case (*R.* v. *Wiseman*), a man was indicted for having committed this offence with a woman, and the majority of the judges held that this was within the statute. Some years ago the editor was consulted under the following extraordinary circumstances:—

> A married man refused to have vaginal connection with his wife (there was no impediment), but insisted upon sodomy; this she naturally refused, and wished to obtain a separation on this account. The husband had lived much in the East, and there acquired the filthy habit.

No legal proceedings were instituted within the editor's knowledge. Unless the person is in a state of insensibility, it is not possible to conceive that this offence should be perpetrated on an adult of either sex against his or her will; the slightest resistance would suffice to prevent its perpetration. In 1849 a question on this point was referred to the author from Kingston, Jamaica. A man was convicted for the crime of sodomy alleged to have been committed on the complaining party while he was asleep. The only evidence against him was the statement of the complainant. The opinion given was that the perpetration of the act during a state of natural sleep was contrary to all probability. The remarks already made in reference to rape during sleep may be applied with greater force to acts of this nature (see pp. 113 *et seq.*). If the crime be committed on a boy under fourteen years it is felony in the agent only; and the same, it appears, as to a girl under twelve [probably sixteen now, Ed.] (Archbold, p. 409). If both are over fourteen and both consent the law regards the passive agent as equally guilty with the active agent. The act must be in the part where it is usually committed in the victim or associate of the crime, and if done elsewhere it is not sodomy. The facts are commonly sufficiently proved without medical evidence, except in the cases of young persons, when marks of physical violence will in general be sufficiently apparent. In some instances, proof of the perpetration of the crime may be obtained by resorting to microscopical evidence. Stains upon the linen of young persons may thus furnish evidence that the crime has been attempted, if not actually perpetrated.

Pederastia is simply that form of buggery in which the passive rôle is played by a boy.

MEDICAL EVIDENCE OF THE OFFENCE.

General.—It is asserted that those who are in the habit of practising sodomy (sodomites) exhibit certain general characteristics; but as some undoubtedly do not show such stigmata it is unnecessary to enumerate them.

Local.—It is not to be expected that any evidence at all would be found on the penis of the active agent unless it were examined immediately after the perpetration, and even then semen would be no use, for self abuse is not a punishable (by law) offence; the only possible evidence obtainable would be the peculiar smell of the anal glands transferred possibly to the penis, and possibly also traces of fæces on the organ. Dixon Mann relates a case where a police surgeon deputy examined the penis of the passive and the anus of the active agent, a mistake it is well to avoid.

Unless an examination is made soon after the perpetration of the crime, the signs of it in the passive agent will disappear. In the case of one long habituated to these unnatural practices, certain changes have been pointed out as medical proofs, among them a funnel-shaped state of parts between the nates, with the appearance of dilatation, stretching, or even a patulous state of the anus, and a destruction of the folded or puckered state of the skin in this part. There may be also marks of laceration, cicatrices, etc., and sometimes the evidence derivable from the presence of syphilitic disease. The editor has seen this funnel-shaped state well marked in many cases in which there was no reason to suspect the act, and he has no belief in it as a sign of sodomy. It is a sign of disappearance of the fat from the parts.

This condition of parts would represent the chronic state induced by these practices in the patient or succubus. In the recent or acute form, fissure and laceration of the sphincter ani, with bruising and effusion of blood, would be found. The appearances above described as belonging to the chronic stage were met with in the case of Eliza Edwards (Vol. I., *ante*).

This person was found after death to be a man, although he had passed himself off in dress and habits during life as a woman. On examination of the body there was strong evidence that he had been for many years addicted to unnatural habits. It was noticed by all present that the aperture of the anus was much wider and larger than natural. There was a slight protrusion and thickening of the mucous membrane at the margin. The rugæ or folds of skin which give the puckered appearance to the anal aperture had quite disappeared, so that this part resembled the labia of the female organs. The lining membrane was thickened at the verge of the anus and was in an ulcerated condition. The male organs had been drawn up and secured by a bandage bound round the lower part of the abdomen. A short account of this remarkable case of concealed sex was published in the *Lond. Med. and Physical Jour.*, February, 1833, p. 168.

Tidy, L.M., 2, 230, adds the following remarks on evidence: "Marks of violence, other than local injuries, are not common in these cases, because the act is usually committed with consent."

There are a few cases where, in a charge of sodomy, **stains of semen** can constitute important evidence. For instance, seminal stains on the garments of a child too young to have emissions (more particularly if they occur on the *posterior* portion of such garment) constitute material evidence. Or again, if they occur on the posterior portion of the shift of a woman who claims to have been unnaturally violated (although in such case corroborative proof is required to render the fact of much avail as evidence), they may prove important in support of the charge. Manifestly, a seminal stain on the garment of an adult male is of no value whatsoever.

At a post-mortem in such cases, it will be advisable to note whether there is evidence of the boy or adult having been *gagged*. Further, it must not be forgotten that dilatation of the rectum and protrusion of the intestines through the anus are common effects of putrefaction. A gaping anus with a thickened mucous membrane at its margins, and smoothness of the skin around, are characteristics specially to be looked for, whilst chancres or scars of chancres on the mucous membrane of the rectum would be specially significant.

This crime is unhappily frequent in Lancashire, hardly an assize being held in Manchester or Liverpool where one or more of these cases are not tried. The crime is not unfrequent among seamen. In a case tried at Liverpool in 1884 it was proved that a sailor had induced a lad to go to sea in order that he might act as the prisoner's passive agent.

The lad was unaware of this, and on the offence being committed denounced the prisoner to the rest of the crew, who complained to the captain, and the prisoner was given in charge to the authorities at the port in South America. The consular authorities inquired into the case, but sent the prisoner home for trial in England. The boy was examined by Lowndes, who found him suffering from pain in the anus and rectum, although this was some time after the committal of the offence. The prisoner was convicted, and sentenced to twenty years' penal servitude. In another case where Lowndes gave evidence the prisoner, a blind man, was charged with committing this offence upon his own son, a boy of twelve, who was himself the subject of partial paralysis. There were indications that the crime had been committed. The jury found the prisoner guilty of the attempt, and he was sentenced to ten years' penal servitude.

R. v. *Woods.*—At the Liverpool Summer Assizes, 1887, before Mr. Justice Day, Thomas Woods, forty-three, a blind man, was charged with having, at Liverpool, on July 5th, committed an unnatural offence on his son William Woods, aged nine years. The jury found prisoner guilty of an attempt at the commission of the offence, and he was sentenced to the maximum term allowed by law—ten years' penal servitude.

Trials for this crime are not infrequent, but the reports of evidence are not made public. *R.* v. *Wilde* is one of the most notorious for some years, as the defendant claimed to be, and was, for some time a leader of taste and art in certain circles. There cannot be any doubt that false charges are as common as in cases of rape. They are made for the purpose of extortion, and as the publication of such a charge, even when unfounded, is greatly dreaded, and has actually led to suicide, it often proves a successful method of extortion. It is especially deserving of notice that such accusations are frequently made by soldiers and policemen.

The case of *R.* v. *Boulton and Park* (Q. B., May, 1871) drew public attention to this subject.

The charge against the defendants was that of conspiracy to commit or to incite to the commission of immorality. The defendants were young men who had for some time gone about to public places dressed as women, and had been seen on public occasions to associate with men as if they were women of the town. They were beardless youths, and one of them, Boulton, had a countenance so feminine, that when seen by the medical examiners he appeared like a young woman in man's clothes. When dressed as fashionable women, they imposed upon all who saw them. These practices had gone on at intervals for one or two years before they were detected and exposed. The defence was, that they had dressed themselves as women for the purpose of performing at private theatricals, but this did not account for all the circumstances proved against them by eye-witnesses, as well as by their correspondence with many persons who were believed to be accomplices. They also assumed female names, and used them in correspondence with men. "They habitually walked the streets and frequented places of public amusement in women's clothes, practising all the petty arts of prostitutes, submitting to be entertained as such by gentlemen, and then suddenly resuming the privileges of their own sex." It was suggested by the course of proceedings that the defendants had not only conspired to commit, but had actually committed, a felonious crime; but of this no proof was offered, and after a lengthened trial the jury returned a verdict of not guilty. The defendants had been examined before the trial by a number of medical men engaged for the prosecution and defence, including Mr. Gibson, the surgeon of Newgate, and the author, acting on the part of the Crown. The medical opinions differed, but at the date of examination there was no distinct evidence that any unnatural offence had been perpetrated.

Schoolmasters are occasionally charged (one near Oxford in 1903 and another in London, 1904) with criminal offences in connection with their scholars. It seems probable that in many such cases mutual or one-sided masturbation may be alone practised.

R. v. *Smith and another* (C. C. C., Old Bailey, April 10th, 1877, before Mr. Justice Manisty).—Case of sodomy. Smith was condemned to penal servitude for life, and the other prisoner to ten years' penal servitude. Smith (aged thirty-five) was a thick-set muscular man, with dark bushy beard and whiskers. He was not at all feminine in appearance, but was dandified in dress, and went by the name of Captain Smith. He had debauched about fifty lads employed in the telegraph service of the General Post Office. His custom was to enter into conversation with the boys, give them wine, suppers, spirits, cigars, etc., to show them indecent pictures, and finally commit unnatural crimes upon them. No medical evidence was taken.

The following remarks are by Dr. Sutherland (*Ind. Med. Gaz.*, June, 1902):—

"**The Signs of Passive Pæderasty.**—Into the description of these Tardieu and others have gone at considerable length, with the result that to many minds the 'infundibulum' and the 'triangular sodomitic wound' are a *sine quâ non* of passive pæderasty. Undoubtedly Tardieu and his school did see what they describe, and where these signs are present the evidence is complete; but where they are absent the innocence of the accused should not be presumed in all cases. Witness the following case:—A Brahmin, aged about forty, sought treatment for what he said was a boil on the perinæum. On examining the 'boil,' I found it to be a typical Hunterian chancre, situated one inch in front of the anus, and on being questioned the patient admitted that he might have contracted it from one of his friends. He volunteered the statement that he had been a pathic for at least twenty years, so I examined him for the classical signs of his aberration, and found none of them. The genitals were well formed, there was no deformation of the anal region, no infundibulum nor loss of rugæ, and the tone of the sphincter was normal."

On this unsavoury subject Mr. S. B. Atkinson has kindly given the editor the following references:—

R. v. *Jellyman*, 1838 (8 C. & P. 604), here with his own wife.—If with consent, the pathic (other party) an accomplice, and hence cannot be called as a witness.

R. v. *Reekspear* (1 Moo. C. C. 342)
R. v. *Cozens* (6 C. & P. 351) } .—If *res in re* (penetration) effected, the crime is complete, otherwise an attempt (with ten years' penal servitude).

R. v. *Jacobs* (R. & R. C. C. 331).—Must be in ano. Into child's mouth does not constitute the offence.

"*R.* v. *Brown* (24 Q. B. D. 357), 1890.—Domestic fowl was used—guilty of attempt (twelve months' imprisonment with hard labour)."

Tribadism.—This word means the gratification of the sexual desire of a woman by a woman. It would be unnecessary to mention it here, for there can be very little chance of medical evidence establishing proof of the act, and, moreover, it is not an indictable offence, but the following letter, omitting names and address, was written on March 15th, 1897, to Dr. Stevenson. The answer is, of course, No.

"DEAR DR. STEVENSON,—Is tribadism a criminal offence? and if so would the commission of it by a married woman enable her husband to obtain a divorce supposing it could be proved? These problems were submitted to me by a medical friend, and I find so very little on this unsavoury subject that I venture to see if your experience can help me.

"My friend sent the married lady in question abroad a short time ago to travel with a nurse on account of great sexual excitability and suspected masturbation, and it seems that whilst abroad she has been guilty of tribadism with a lady friend. This having come to the knowledge of the husband, he has been to his mother-in-law and told her that her daughter has been guilty of a criminal offence, and that he is going to obtain a divorce.

"I apprehend that the proof would have to be furnished entirely by other than medical evidence. Have you any experience on this subject?

"My own experience is that the problem is purely a legal one.

"Apologising for thus troubling you.

"Believe me,
"Yours faithfully."

The letter shows how blackmail might be demanded. The act commonly arises in women with nymphomania, and its alleged occurrence would suggest an inquiry into her mental state.

Bestiality.—The Germans apply the term sodomy to the unnatural intercourse of man with animals (Casper, "Gerichtl. Med.," vol. 1, p. 180). To this we more commonly give the name of *bestiality.* Trials for this crime perpetrated with animals, such as the cow, the mare, and the she-ass, are not unfrequent at the assizes. They are not reported, and do not therefore attract any public notice. The criminals are commonly youths or men employed to look after the animals. In most of these cases the criminal has been caught *flagrante delicto*, or under such circumstances as to leave no doubt of the attempt, if not of the completion, of the act of unnatural intercourse.

Medical evidence is seldom required to sustain the prosecution. There may be, however, circumstances which can only be properly interpreted by an expert. The hair of the animal may be found on the perpetrator, or marks of blood or feculent matter upon his dress, and in such cases analysis, or the microscope, may enable a witness to express an opinion in proof or disproof of the charge. It would obviously be more important to discover animal hairs on the under-clothing than on coat, trousers, etc.

In one case tried at the assizes, where a man was charged with having had unnatural intercourse with a cow, the prosecution was able to show that some short coloured hairs found on the prisoner's person resembled those of the animal. In another case (*R.* v. *Brinkley*, Lincoln Ass., April, 1887) Sir Thomas Stevenson found the peculiar coloured hairs of a mare upon the prisoner's clothes, and spermatozoa on his trouser-flap.

The medical jurists of Germany have taken a great interest in cases of sodomy and bestiality; and in some of their reports they have contrived to throw an air of science over the details of this detestable crime. Kutter has published an elaborate report of a case of this kind ("Fleischlicher Vermischung mit einem Thiere"), in which a sub-officer was charged by his captain with unnatural intercourse with a mare, and in support of the charge Kutter was able to furnish good microscopical evidence.

The captain, on entering the stable suddenly, found the prisoner in the act of moving away from the stall of the animal. Kutter was called to examine the mare, and found some small abrasions about the genitals of the animal, and a slight escape of bloody mucus from these parts. The prisoner willingly submitted himself to examination. Kutter found some stains of blood on his shirt; and on the penis between the prepuce and the glans there were a number of short, dark, pointed hairs. The prisoner accounted for them by saying that the night before he had had connection with some woman. Kutter examined the hairs carefully by the aid of a miscroscope, and found them to be shorter, thicker, and more pointed than those of a human being. They were also coarse, and less transparent. Comparing them with hairs gently rubbed off the back part of the mare, they exactly corresponded in colour, form, and length, so as to leave no doubt on his mind that there had been unnatural intercourse. It was impossible to say with any certainty that the blood-stains on his shirt were produced by the blood of the animal. This, however, was not a necessary part of the evidence (Horn's *Vierteljahrsschr.*, 1865, 1, p. 160). On these facts Kutter gave an opinion that the prisoner had been guilty of unnatural intercourse with the mare.

With regard to all these filthy crimes the editor feels it his duty to add a few words of comment as to the cause of them.

It has to be admitted that the sexual passion or feelings are stronger in some people (of both sexes) than in others, and it is only education and decent social environment that keeps them in check. If then a charge of unnatural sexual gratification be brought against anyone, it is but fair to inquire into his or her educational advantages and social surroundings in apportioning a punishment to fit the crime.

Further, it must again be admitted that undue sexual passion is frequently not merely a cause of lunacy, but is actually evidence of lunacy, and the victim of it is more properly treated by confinement to a lunatic asylum than by imprisonment amongst ordinary criminals.

Lastly, and a most important point, there is abundant medical experience, really available as medical evidence, to show that bodily states may account for pathological increase in sexual desire and passion, and so lead to crime. These states may be, in younger people, actual disease (Herpes preputialis, for example) capable or not of cure, and in older males there is a condition (? disease), "enlarged prostate," which is most certainly a direct provocative, in many cases, to the commission of crime. Such a condition can hardly be urged as an excuse, but it can be offered as an explanation, and what is more to the point, it is a condition capable of cure by operation, and it might seem but right to offer to an elderly man the alternative of submitting to a cure before actually condemning him to a period of penal servitude, the results of operation to be awaited before passing sentence.

SECTION XVI.

POISONING OR TOXICOLOGY.

This constitutes a large and very important section of forensic medicine, and for convenience of discussion may be sub-divided into the following sub-sections, viz.:—

Sub-section A. The Law on Poisons, including the definition of a Poison or Noxious Thing.
„ B. How Poisons Act, and the Circumstances that influence their Action.
„ C. The Diagnosis of Poisoning.
„ D. What to do in Cases of (suspected or proved) Poisoning.
„ E. Poisoning by the various (Groups of) Individual Poisons.

SUB-SECTION A.—THE LAW ON POISONS, INCLUDING THE DEFINITION OF A POISON OR NOXIOUS THING.

"1. *Whosoever shall administer, or cause to be administered to or taken by, any person, any poison or other destructive thing, with intent to commit murder, shall be guilty of felony.*

"2. *Whosoever shall unlawfully and maliciously administer to, or cause to be administered to, or taken by, any other person, any poison or other destructive or noxious thing, so as thereby to endanger the life of such person, or so as thereby to inflict upon such person any grievous bodily harm, shall be guilty of felony.*

"3. *Whosoever shall unlawfully and maliciously administer to, or cause to be administered to or taken by, any other person any poison or other destructive or noxious thing, with intent to injure, aggrieve, or annoy such person, shall be guilty of a misdemeanour.*

"4. *If, upon the trial of any person charged with the felony above mentioned, the jury shall not be satisfied that such person is guilty thereof, but shall be satisfied that he is guilty of the misdemeanour above mentioned, then, and in every such case, the jury may acquit the accused for such felony and find him guilty of such misdemeanour.*

"5. *Whosoever shall, by any means other than those specified in any of the preceding sections of this Act, attempt to commit murder, shall be guilty of felony.*

"6. *Whosoever shall unlawfully apply or administer to, or cause to be taken by, or attempt to apply or administer to, or attempt to cause to* *be administered to or taken by, any person, any chloroform, laudanum, or other stupefying or overpowering drug, matter, or thing, with intent, in any of such cases, thereby to enable himself or any other person to commit, or with intent, etc., to assist any other person in committing, any indictable offence, shall be guilty of felony.*

Such is at the present time the English law on the subject of poisoning so far as it affects medical men and their evidence, and around these very important paragraphs many momentous issues and decisions have collected, and many very hotly contested arguments have been held. The reader will find much interesting information on the law on the subject in "The Law in Relation to Poisons," by Glyn Jones, 1909.

Definition of a Poison.—Before the words "destructive" and "noxious thing" were introduced into the law, the definition of what was and what was not a poison was a matter of the very highest importance. Now the definition is really of but little more than historical interest, except in so far that a cross-examining counsel may legitimately ask a medical witness for his (the witness's) definition with a view to showing either bias or ignorance in the witness's mind. An attempt must therefore be made to suggest a sufficient definition.

A poison is commonly defined to be a substance which, when administered or taken *in small quantity,* is capable of acting deleteriously on the body. In popular language, this term is applied only to those substances which destroy life in small doses. This popular view of the nature of a poison is too restricted for the purposes of medical jurisprudence. It would obviously exclude numerous compounds the poisonous properties of which cannot be disputed, as for example, the salts of copper, tin, zinc, lead, and antimony. These, generally speaking, act as poisons only when administered in quantities which in *medicinal* language would be called large doses. Some substances, such as nitre or chloride of sodium (common salt), have not been observed to have a noxious action except when taken in quantities which in *popular* language would be called large, while arsenic, on the contrary, acts as a poison in a small dose; but in a medico-legal view, whether a man dies from the effects of an ounce of nitre or two grains of arsenic, the responsibility of the person who criminally administers the substance is the same. Each may be regarded as a poison, differing from the other only in its degree of activity and in its mode of operation. The result is the same: death is caused by the substance taken; and the *quantity* required to destroy life, even if it could be always accurately determined, cannot enable us to distinguish a poisonous from a non-poisonous substance. If, then, a medical witness be asked, "What is a poison?" he must beware of adopting this popular definition, or of confining the term poison to a substance which is capable of operating as such in a small dose taken once.

In legal medicine, it is difficult to give such a definition of a poison as shall be entirely free from objection. Perhaps the most comprehensive which can be suggested is this:—"A poison is a substance which, when taken into the mouth or stomach or when absorbed into the blood, is capable of seriously affecting health or of destroying life by its action on the tissues with which it immediately, or after absorption, comes in contact." There are various channels by which poisons enter the blood: some are in the form of gases or vapours; these operate rapidly through the lungs: others are liquid or solid, and these may reach the blood either through the skin or through a wound, but more commonly through the lining membrane of the stomach or bowels, as when they are taken or administered in the ordinary manner. The latter chiefly give rise to medico-legal investigations. Some substances act as poisons by any one of these channels; thus arsenic is a poison whether it enters the blood through the lungs, the skin, or the stomach and bowels: but such poisons as those of snakes, of rabies, and of glanders, appear to greatly affect the body only through a wound in the skin. When introduced into the stomach, these animal poisons have been found to be almost inert. This subject will be further considered (*vide* "Animal Poisons").

It will be noticed that this definition certainly includes the great class of corrosives and also most of the mechanical bodies, such as powdered glass.

It is not possible in the abstract to define the boundary between a medicine and a poison. It is usually considered that a medicine in a large dose is a poison, and a poison in a small dose is a medicine; but a medicine such as tartarated antimony may be easily converted into a poison by giving it in small (medicinal) doses at short intervals, either under states of the body not adapted to receive it, or in cases in which it exerts an injuriously depressing effect. Some deaths have been occasioned by this wilful misuse of antimony in doses which might be described as *medicinal*, although in the cases referred to no other intention could have existed, in the secret administration of this substance, than that of destroying life. A person may die either from a large dose of a substance given at once, or from a number of small doses given at such intervals that the system cannot recover from the effects of one before another is administered. This remark applies to a great number of medicines which are not commonly included in a list of poisons. In fact, the only real difference between a medicine and a poison is the *intent* with which they are purposely, not accidentally, given, the one to save life or cure disease, the other to destroy life or simulate disease.

If we cannot in the abstract thus define a poison we have in the schedules of the Pharmacy Act of 1868 a means whereby certain substances, at any rate, are by the law defined as poisons; and it is very germane to the present work to consider some points in connection with that Act.

It was passed in 1868 as a means for reducing the dangers to human life, by restricting the indiscriminate sale of poisons by all and sundry. In it certain substances were scheduled in two lists as being too dangerous to be indiscriminately sold to the public, by ordinary shopkeepers, without special precautions; it also had the object of enabling the police and others to more easily trace poisons which had been used for criminal purposes. The Act has not succeeded in entirely avoiding the improper use of the substances, nor could it be expected to do so, but it has been, and continues to be, of most material use to the public, and to the ends of justice.

As regards the lists of substances, with those in List I. a registration of the sale is compulsory, and the poisons are not allowed by the Act to be sold unless the purchaser is known to, or introduced by some person known to the seller, the purpose for which the poison is wanted having to be entered in a book provided for the purpose, whereas those in List II. merely have to be labelled with the name of the substance, the word "Poison," and the name and address of the seller. The following are the poisons at present arranged in these lists :—

List I.

Aconite and its preparations.
Alkaloids : all poisonous vegetable ones, and their salts.
Arsenic, and its preparations.
Atropine, and its preparations.
Cantharides.
Corrosive sublimate.
Cyanide of potassium ; all metallic cyanides, and their preparations.
Emetic tartar.
Ergot of rye, and its preparations.
Prussic acid, and preparations of it.
Strychnine, and preparations of it.
Vermin killers, if preparations of poisons the preparations of which are in Part I.

List II.

Almonds, essential oil of, unless deprived of prussic acid.
Belladonna, and its preparations.
Cantharides, tincture of, and all vesicating liquid preparations of cantharides.
Chloral hydrate, and its preparations.
Chloroform.
Corrosive sublimate, preparations of.
Mercury, red oxide of, and ammoniated.
Morphine, preparations of.
Opium and all preparations of opium, and of poppies.
Oxalic acid.
Phenol, and its preparations.
Vermin killers, containing poisons not subject to the provisions of Part I.

Carbolic acid has only lately been added to the list, owing to the action of the Pharmaceutical Society, which may, through its council, declare by resolution any substance to be a poison. Such resolution requires the confirmation of the Privy Council to be effective. The following is taken from the *B. M. J.*, 2, 1902, p. 229 :—

> "On July 4th, 1900, a resolution was passed by the Pharmaceutical Society which declared that liquid preparations of carbolic acid and its homologues containing more than 3 per cent. of those substances (except any preparation prepared as a sheep wash or for any other purposes in connection with agriculture and horticulture, and contained in closed vessels distinctly labelled 'Poisonous') should be added to Part II. of Schedule A. This resolution was confirmed on July 27th, 1900, and is now in force.
>
> "The Act of 1868 also authorised the Society to frame regulations for the keeping, dispensing, and selling of poisons. Some thirty years after the passing of the Act—to be exact, on January 11th, 1899—the Pharmaceutical Society did adopt such regulations, and they were duly confirmed. On May 28th, 1902, the Society passed a further regulation, the effect of which is to require that liquid disinfectants, like liniments, embrocations, and lotions, if they contain scheduled poisons, should be sent out in bottles rendered distinguishable by touch from ordinary medicine bottles, and that there should also be affixed to each such bottle, in addition to the name of the article and to any particular instructions for its use, a label giving notice that the contents of the bottle are not to be taken internally. [The regulations now stand as follows (*London Gazette*, July 4th, 1902)] :—

"1. That in the keeping of poisons each bottle, vessel, box, or package containing a poison be labelled with the name of the article, and also with some distinctive mark indicating that it contains poison.

"2. Also that in the keeping of poisons each poison be kept on one or other of the following systems, namely—

(*a*) In a bottle or vessel tied over, capped, locked, or otherwise secured in a manner different from that in which bottles or vessels containing ordinary articles are secured in the same warehouse, shop, or dispensary; or

(*b*) In a bottle or vessel rendered distinguishable by touch from the bottles or vessels in which ordinary articles are kept in the same warehouse, shop, or dispensary; or

(*c*) In a bottle, vessel, box, or package kept in a room or cupboard set apart for dangerous articles.

"3. That in the dispensing and selling of poisons, all liniments, embrocations, lotions, *and liquid disinfectants* containing poison to be sent out in bottles rendered distinguishable by touch from ordinary medicine bottles, and that there also be affixed to each such bottle, in addition to the name of the article and to any particular instructions for its use, a label giving notice that the contents of the bottle are not to be taken internally."

In February, 1903, a departmental committee appointed by the Lord President of the Council issued a report on Schedule A of the Pharmacy Act (*vide Lancet*, 1, 1903, p. 599), chiefly with reference to restrictions in trade in poisonous vermin killers, etc. As a consequence of the report of this committee the new Poisons and Pharmacy Act became law on April 1st, 1909. It is chiefly concerned with the sale of arsenic and nicotine, and with defining the status of companies for the sale of potent drugs. It also enlarges the power of the Pharmaceutical Society to make bye-laws.

It is very easy to find fault with the schedules both for what they contain and what they omit. For instance, "all vegetable *poisonous* alkaloids" is simply begging the question entirely, while a list which does not contain croton oil, tincture of digitalis, nor any lead salts, etc., etc., must certainly be considered very imperfect. Moreover, all poisonous substances which can be extracted from vegetables are not alkaloids—for instance, digitalein and strophanthin are both glucosides; but the point is, perhaps, hardly worth labouring in a work on forensic medicine, though it is easy to conceive how questions and cases might easily arise around the definitions of these scheduled poisons. In April, 1905, the Council of the Pharmaceutical Society passed the following resolution:—

That by virtue and in exercise of the powers vested in the Council of the Pharmaceutical Society of Great Britain, the said Council do hereby resolve and declare that each of the following articles—namely, cocaine and its salts, picrotoxin, acetanilide, preparations of cocaine, digitalis and its preparations, mercuric iodide, mercuric sulphocyanide, soluble salts of oxalic acid, strophanthus and its preparations, sulphonal—ought to be deemed a poison within the meaning of the Pharmacy Act, 1868; and also that of the same, each of the following articles—namely, cocaine and its salts, picrotoxin—ought to be deemed a poison in the first part of the Schedule A to the said Pharmacy Act, 1868.

The analogous question of poisoning in ordinary occupations trenches too much upon the domain of public health to be discussed here. The reader is referred to the following for more information:—"Dangerous Trades," edited by Thomas Oliver, with numerous contributors (Murray, 1902); reports of the Chief Inspector of Factories and Workshops issued as blue-books from time to time; "Notifications of Industrial Poisoning Cases under the Factory and Workshops Act of 1901"; "Poison Legislation," by Sir James Creighton Browne, an address to the Pharmaceutical Society (*Lancet*, 2, 1898, p. 929). *Vide* also Blyth's "Poisons," 3rd ed. (1895); "The Effects of the Factory System," by Allen Clarke (1899); also remarks on the Workmen's Compensation Act in the present work, Vol. I.

There is an amusing and interesting article in the *Pharm. Jour.*, 1898, p. 691, on historical cases of poisoning from Socrates to Aguinaldo; *vide* also C. J. S. Thompson, "Poison Romances and Poison Mysteries" (1899).

Definition of Noxious Thing.—It is impossible to lay down any abstract rules as to what may and what may not be considered a noxious thing within the meaning of the Act. As an extreme illustration we might mention a piece of plum-pudding given to a new-born infant. No one could contend that the Act specifically intended to include that article as a noxious thing, and yet we see that it might be very noxious. This principle will have to be fully considered (*vide* below, "How Poisons act and the Circumstances that influence their Action"). The medical witness must be prepared to show that the "thing" was "noxious" under the given circumstances.

It has, however, been laid down by the law (*R.* v. *Hennah*, Cornwall Ass., 1877) that a noxious thing must be given in a quantity capable of producing noxious effects in order to come under the law's definition of a "noxious thing." Moreover, judges exercise a certain discretion in deciding between a substance which is essentially noxious and one that is only noxious by reason either of its excess or from the circumstances attending its exhibition.

For all this, there can be no doubt that the intention of the law in using the words "destructive or noxious thing" was to prevent the escape of a malicious scoundrel on any simple technical plea that the substance was not a poison. On such false grounds white precipitate, white hellebore, lobelia inflata, and oil of turpentine, have, in days gone by, been declared not to be poisons.

Again, the substance administered may not be a poison in the medical signification of the term, and may not be popularly considered as such; yet when taken it may be noxious to health or destructive to life. We have examples of substances of this description in iron filings, powdered glass, diamond dust, sponge, pins and needles, and such-like bodies, which have been administered with the wilful design of injuring, and have on various occasions given rise to criminal charges. In cases of this kind, the legal guilt of a prisoner may often depend on the meaning assigned by a medical witness to the words *destructive thing*. Thus, to take an example, liquid mercury might be poured down the throat of an infant with the deliberate intention to destroy it. A question of a purely medical nature will then arise whether mercury be a "destructive thing" or not; and the conviction of a prisoner will probably depend on the answer. Should a difference of opinion exist, the prisoner will receive the benefit of the doubt.

In March, 1874, a man was charged, under the Adulteration Act, with selling lozenges containing powdered glass and blue starch. Dr. Bernays, who gave evidence respecting the adulteration, was asked whether the glass was injurious to health. His reply was that it was not, unless taken in large quantity by children, and here the quantity was very small. The case was dismissed. Prosecutions under the Adulteration Act (35 & 36 Vict. c. 74, August, 1872) have given rise to many inquiries respecting the poisonous or injurious nature of a variety of substances mixed with articles of food.

Dr. Letheby found 40 per cent. of iron filings and 19 per cent. of silica in the form of fine sand in certain kinds of tea. Prussian blue, French chalk, and yellow colouring matter have been detected in green teas, red oxide of iron in anchovy sauce and paste, and red lead in snuff. In all these cases the analyst must be prepared to state whether such substances are or are not poisonous and injurious to health.

It is very certain that Dr. Bernays was wrong in his opinion in regard to glass. The Adulteration Act hardly seems to be the best way of convicting scoundrels who for the sake of a few pounds will run the risk of inflicting upon innocent persons serious ill-health or even death. The difficulty lies with the word "intent" in the laws relating to poisoning.

Intent.—The intent with which any given substance has been applied or administered is the law's essential point. Whether the administering be followed by any bodily injury or not, the act is a felony or misdemeanour provided that intent to murder or annoy can be proved.

A medical man was charged with "attempting to cause to be administered" to an infant a poisonous dose of laudanum. It was stated by a woman who nursed the child that the accused delivered to her two bottles containing a brown liquid, labelled "One teaspoonful every three hours," and directed her to give it to the child. None was given. Some months after the death of the child from natural causes this charge was raised, and the bottles, still full of liquid, were produced as evidence against the accused. On analysis the prescribed dose contained about five minims of laudanum, or nearly one half-grain of opium—a dose likely to prove fatal to an infant only a month old. Assuming the statement of the nurse who made the charge to be true, the only inference to be drawn from the prescription of such a dose for an infant by a medical man would be that he intended to destroy the life of the child. The charge fell to the ground, as clear proof was given that the woman who made it was not to be believed on her oath, and that it had originated in a desire to extort money.

Poison on many occasions has been mixed with food, and thus administered with a view to injure or annoy a person.

Cantharides has been thus frequently given, and in one instance (November, 1859) eight members of a family suffered from severe symptoms of poisoning by reason of the wanton administration of this drug. In April, 1860, several members of a family suffered from severe sickness as a result of tobacco having been put into water contained in a tea-kettle; and tartar emetic has been in some cases dissolved in beer or other liquids as a mere frolic, without any proved or probable intention on the part of the offender to destroy life. The case of *M'Mullen* (Liverpool Aut. Ass., 1856) revealed an extensive system of poisoning in the northern counties, in which tartar emetic was the substance employed. This drug, mixed with cream of tartar, was openly sold by druggists under the name of "quietness powders," and the evidence established that women gave these powders to their husbands with a view to cure them of habits of drunkenness.

Before the passing of the Act from which the quotations at the head of this section are taken, when the intent to murder had not been proved the offender has escaped, although great bodily injury might have been done by his wanton or malicious act.

The **quantity** of a poisonous substance found in an article of food, or in a dead body, **does not affect the culpability** of a person indicted for administering it. In the case of *Hartley* (C. C.C., May, 1850), in which an attempt was made to administer sulphuric acid mixed with coffee, Cresswell, J., stated, "If poison be administered with intent to murder, it is not necessary there should be enough in the article administered to cause death. If any poison be there, and the intent be proved, the crime of attempting to administer poison is complete." Erle, J., ruled to the same effect in reference to the discovery of a small quantity of arsenic in a dead body (*R.* v. *Bacon*, Lincoln Sum. Ass., 1857). In *R.* v. *Southgate*, Parke, B , said, in reply to an objection taken, it was quite immaterial to define or prove in what vehicle a poison was given, or whether it was administered in a solid or liquid state.

Now medical evidence obviously cannot have any direct bearing on intent, but indirectly it may have a bearing which is absolutely conclusive, as witness the case just quoted of a dose of five minims of laudanum to an infant. Thus drugs perfectly innocent in themselves, doses quite within medicinal limits, methods quite appropriate under other circumstances, may all be used with criminal or annoying intent, and medical evidence will possibly be thus the only means of proving intent by showing that any of the above factors were inappropriate for the particular case in which they were utilised.

In reference to intent it is necessary to observe that the law does not regard **the manner** in which the substance administered acts. If it be capable of destroying life or of injuring health it is of little importance, so far as the responsibility of a prisoner is concerned, whether its action on the body is of mechanical or chemical nature, or whether it operates fatally by absorption into the blood or not. Thus a substance which simply acts mechanically on the stomach or bowels may, if wilfully administered with intent to injure, involve a person in a criminal charge as much as if he had administered arsenic or any of the ordinary poisons. If the substance criminally administered destroys life, whatever may be its nature or mode of operation, the accused is tried on a charge of murder or manslaughter, and the duty of a medical witness consists in showing that the substance taken was a certain cause of death. If, however, death be not the consequence, then the accused may be tried for the attempt to murder or annoy by poison (*vide* Statutes, *supra*). The words of the statutes are general, and embrace all kinds of substances, whether they are popularly or professionally regarded as poisons or not.

This question of "intent" may present itself under another aspect.

In *R.* v. *Cluderay* (Exch. Chamber, Jan. 19th, 1849), the prisoner was indicted for administering poison with intent to murder. He was proved to have administered to a child nine weeks old two berries in the husk of *Cocculus Indicus*, and the berries passed through the body of the child without doing any injury.

It was submitted for the prisoner that, being in the husk, they could not be considered a poison. The point was reserved by Williams, J., who tried the case at York. It was now contended for the prisoner that, although the kernel of this nut was poisonous, still, having been given in the husk, which was hard of digestion, it could not be considered an administering of poison within the statute. The Chief Justice said the Court was of opinion that when a man administered something that was poison with intent to murder, but in such a way that it did not act, he was guilty. Conviction affirmed. This is the only reasonable view to take of such a frivolous objection. The seed contains the poison, but the husk is inert; nevertheless the berry as a whole must be regarded as a poison.

SUB-SECTION B.—HOW POISONS ACT, AND THE CIRCUMSTANCES THAT INFLUENCE THEIR ACTION.

With such wide and indefinite ideas of a "poison" and of a "noxious thing," medical evidence becomes at once easier and more difficult—easier because it has not to tie itself down to so hard and fast rules and definitions ("deadly" poison, for instance, has been held by Erle, J., to be mere legal surplusage, and may be neglected); more difficult because the medical jurist must be very accurately and certainly acquainted with all the varying influences which affect the action of drugs and all other substances which might be termed noxious. They are not scheduled by law except as above for certain purposes.

If any doubts formerly existed whether the *external* application of poisons, *e.g.*, by wounds or ulcerated surfaces, would be included in the words "administering or taking," they are now entirely removed by the Criminal Law Consolidation Act, 1861. The 22nd section specially applies to such an offence (*vide* numbered paragraph 5, *supra*, p. 299).

Poisons and noxious substances then may act—

A. **Locally** on application either to skin or stomach.
  Corrosives—*e.g.*, strong acids and alkalies.
  Irritants { General—*e.g.*, weaker acids or alkalies, mustard, many minerals, mechanical bodies, such as powdered glass, etc.
  Irritants { Nervous—*e.g.*, aconite, carbolic acid, etc.

B. **Remotely**, after absorption into the blood, or by shock.
  By shock—*e.g.*, the shock of corrosives, hydrocyanic acid (?).
  By specific selection after absorption—
    On brain—narcotics: opium, chloral, etc.
    „ „ excitants: alcohol, Cannabis Indica, etc.
    On cord—strychnine, tobacco, etc.
    On peripheral nerves—conium, curare, etc.
    On kidneys—cantharides, cubebs, turpentine, etc.
    On salivary glands—mercury, etc.
    On the liver—phosphorus, etc.
    On mucous membranes—arsenic, etc.
    On heart—digitalis, etc.
    On bloodvessels—constringent: ergot, etc.
      dilating: amyl nitrite and other nitrites, etc.

C. In both ways, **locally and remotely**.
  Typically oxalic acid, carbolic acid, antimony, cantharides, etc., irritating locally in the stomach, and certainly possessing unpleasant powers after absorption.

Only the most typical examples have been given under each heading. A complete list means merely completing the *materia medica* (official and non-official) and adding a large number of plants, minerals, and artificial organic chemical compounds, for they can nearly all be shown to be noxious under certain circumstances.

Illustrative cases will be found in abundance in the part of this work devoted to special poisons. It remains here to consider the

Circumstances which Influence the Action of Poisons.

A. **Method of Administration.**—1. *By the Mouth.*—This is, of course, the commonest method of all, and hence must be taken as the type in estimating dose, etc. In general it may be taken that if one represent the dose by the mouth one and a half to two may be taken as the rectal dose and about one-quarter to two-fifths or more as the hypodermic dose of a drug.

The chief toxicological point is that any substance (other than corrosives, irritants, gaseous poisons, and a few others, *e.g.*, HCN), taken in this way, has to be digested, or at least absorbed through the gastric mucous membrane, before it produces effects. By the slowness of gastric absorption (*vide* p. 314), or by the action of the liver (through which organ many substances passing from the stomach have to go), some poisons, typically snake venom, would seem to be rendered almost inert. In regard to snake venom this is most marked. The following experiment by Dr. Taylor is very striking: "In June, 1873, Dr. Pavy and I performed two experiments with the dry poison of the cobra di capello, which showed that even in a fasting animal no effects were produced when it was injected into the stomach. Two grains of dry cobra poison were mixed with a small quantity of distilled water and introduced into a wound in the cellular tissue beneath the skin of a rabbit. Symptoms of poisoning showed themselves in a quarter of an hour, and the animal died in twenty minutes afterwards. A similar quantity of the cobra poison was injected into the stomach of a healthy young dog which had been kept without food for many hours. No symptoms of poisoning were at any time observed" (Guy's Hosp. Rep., 1874, and also many other more recent experiments by Dr. Fraser, of Edinburgh).

In regard to other substances and also in the matter of dose it is probable that the principle enunciated on p. 315 with reference to the rates of absorption is responsible, very largely at any rate, for the results.

2. *Hypodermically.*—By this method (chiefly resorted to by medical men and other more skilled individuals, mostly suicidal, rarely homicidal) the substance introduced reaches the general blood stream without passing through the digestive organs. Snake poison can be administered in this way only, if it is to be effective, at least in small doses. Generally speaking, the dose required for lethal results is about a third less than by the mouth, but the exact proportion is of course very variable. The method is, without special precautions (*vide* next paragraph), only available for such substances as are soluble in the lymph or tissue juices.

3. *Intravascularly.*—This method, the opening of a vein and injection of the substance directly into the blood, is only made use of in scientific experiments, though it is conceivable that it may be unintentionally adopted when the point of the hypodermic syringe by accident just penetrates to the lumen of a vessel. It again can only be used for soluble substances unless the results of emboli are to be studied.

4. *Endermically.*—Rubbed on to, and absorbed through, the skin, physiologically identical with the hypodermic method. It is practically only used for ointments, liniments, and plasters, and occasionally powders are dusted on to a raw surface for absorption or for local relief of pain. Poisoning by this means is rarely homicidal—with intent, at least—but occurs rather frequently from carelessness and accident.

5. *By Rectum, Vagina, or Bladder.*—These means are occasionally resorted to with criminal intent, especially in the procuring of an abortion. The dose required is usually considered per rectum to be about twice that by the mouth, owing to the slowness of absorption from this viscus. The following case was reported to the editor by Dr. Lane, of Inverell, New South Wales:—

> An inquest was held in August, 1902, on the body of Selina Eliz. Doolan, who died about twenty minutes after an injection of an enema made by steeping about 1¼ oz. of "Yankee Doodle" tobacco in a quart of boiling water. The public analyst extracted six minims of nicotine from the abdominal viscera of the deceased. A verdict was returned by the coroner's jury to the effect of death by misadventure.

The evidence was very conclusive of the nature of the poison and its method of administration, the latter being chosen for the purpose of relieving constipation.

From the healthy bladder such absorption is commonly denied *in toto*, but irritation is very easily excited by substances which are foreign to the viscus, and this may profoundly alter the physiological powers of absorption of the organ as well as its primary function.

6. *By the Lungs.*—A poisonous dose of any drug may be accidentally given when using intralaryngeal injections and applications; solid pieces of caustic, etc., may also under similar circumstances unintentionally slip down the larynx. Accidents, and even fatal ones, of this kind have occurred, and warrant care in manipulation of dangerous applications to the upper food and air passages. Poisoning by the lungs is, however, commonly the effect of poisonous gases such as CO, CO_2, HCN, PH_3, coal-gas, etc. Accidents with gas-pipes and suicide by the same means are of very common occurrence, and it is easily possible to imagine how homicide might be thus attempted, though its proof would require evidence other than medical. Occasionally death takes place from the lungs when corrosives are taken or when the person is exposed to the fumes of the volatile acids HNO_3 and HCl. Cases will be found under that heading, *vide infra.*

Of comparative dose by the lungs nothing can be said, as the gas may kill by local action, causing spasm or inflammation, by being simply irrespirable, or by its action after absorption, as in deaths from chloroform inhalation by CO or CO_2, etc., etc. (*vide* "Gaseous Poisons," *infra*).

B. **Idiosyncrasy.**—Of the genuine existence of the intolerance exhibited by certain people for certain drugs and even articles of diet there can be no question. Its explanation is extremely difficult and quite speculative. Fish, eggs, and fruit are the commonest illustrations of dietetic articles which will even when quite fresh (so that no question of so-called ptomaine poisoning can arise) cause in some people definite toxic symptoms—urticaria, diarrhœa, albuminuria, etc. The editor is not aware of any case of this kind actually proving fatal, but many cases are reported where the symptoms have been serious and even apparently dangerous. Potassium iodide and bromide, opium, mercury, and belladonna are illustrations amongst drugs with similar peculiarities.

A fatal case occurred in the London Hospital some years ago in which a child lost its life by the administration of one small dose (one or two grains only) of bromide of potassium. The drug produced a severe bromide rash, under which the child sank.

It is difficult to imagine this point being taken advantage of for homicidal purposes, but certainly accidental cases occur with great frequency. The subject of idiosyncrasy is thus of importance in a medico-legal view when symptoms resembling those of poisoning follow a meal consisting of a particular kind of food. In such a case, without a knowledge of this peculiar condition, we might hastily attribute to poison effects which were really due to another cause.

C. **Age.**—This is to some extent connected with, or a variety of, idiosyncrasy. There are, for instance, many articles of diet which may justly be called "noxious" or even poisonous for a baby which are wholesome enough for an adult, and *per contra* a healthy boy will eat many things with impunity that might give his father serious cause for regret. Many cases of criminal neglect in children in all probability depend largely on the unsuitability of the food given to a baby quite as much as on absolute lack in quantity, and a medical jurist must be acquainted with the principles of infant feeding. Before the Baby Farming Act there can be no doubt that many criminals escaped proper punishment owing to a plea that the child had been fed, the fact being overlooked that the food was utterly unsuitable, to use no stronger term. There are also some drugs of which children can take more than their proportionate dose. [This is usually reckoned by the following formula, viz.: taking x to represent the dose for an adult, the dose for any age is $= x \times \frac{\text{age in years}}{\text{age in years} + 12}$; thus for a child of six the dose is $\frac{6}{6 + 12} = \frac{1}{3}$ the ordinary dose for an adult.] Mercury and belladonna are two well-known examples. On the other hand, there are some of which they cannot take a proportionate dose. Opium is here the great example, which has to be given very cautiously indeed to young children. The explanation is obscure, but no doubt depends to a great extent on the fact that a child's tissues (in the case of opium probably the cortex of the brain) are very immature, *i.e.*, usually susceptible to external influences, during the period of growth.

D. **Habit.**—Habit, it is well known, diminishes the effect of certain poisons. Thus it is that opium, when frequently taken by a person, loses some of its effect after a time, and requires to be administered in a largely increased dose. Indeed, confirmed opium-eaters have been enabled to take at once a quantity of the drug which would have killed them had they commenced with it in the first instance. Even infants and children, who are well known to be especially susceptible of the effects of opium, and are liable to be poisoned by small doses, may, by the influence of habit, be brought to take the drug in very large quantities. This is well illustrated by a statement made by Grainger (Rep. of the Children's Employment Commission). It appears that the system of drugging children with opium in the factory districts at that time commenced soon after birth; and the dose was gradually increased until the child could take from fifteen to twenty drops of laudanum at once. This had the effect of throwing it into a lethargic stupor. Healthy children of the same age would be killed by a dose of five drops. The same influence of habit is manifested more or less in the use of tobacco, alcohol, ether, strychnine, and other alkaloids. Christison has remarked that this influence is chiefly confined to poisons derived from the organic kingdom. It is so limited with regard to mineral substances that it can scarcely be said to exist, except with respect to arsenic and corrosive sublimate. There is satisfactory evidence that a human being has accustomed himself, by habit, to take arsenic daily in doses that would prove poisonous to the generality of adults.

In reference to the Styrian practice of arsenic-eating,

Roscoe has published a case in which, according to information supplied to him, a Styrian took in one day four and a half grains of white arsenic, and on the day following five and a half grains, crushing the mineral between his teeth and swallowing it. The day after he had swallowed the second dose the man left the place in his usual health, and there is no further record of him. Knapp states that a man once took in his presence seven and a half grains of arsenic, which did not produce the slightest visible influence on his feelings. A portion of his urine passed on the same and the following day was examined by Marsh's process, and it was found to contain arsenic (*Edin. Month. Jour.*, January, 1869, p. 669). Other cases of a similar kind are related by R. C. Maclagan in the same journal, September, 1864, p. 200. He saw one man swallow between four and five grains of arsenic in powder. This man had been accustomed to take it for a year, beginning with small doses; he did not suffer from any bad effects. A man, æt. 46, swallowed six grains of arsenic, washing it down with cold water. Arsenic was detected in the urine about an hour after the poison was swallowed; but as they were habitual arsenic-eaters, it is probable that the eliminated arsenic may have been from that previously taken.

That such cases as these are of an exceptional nature is proved by a case communicated to the *Edin. Med. Jour.*, 1864, p. 16, by Parker, of Halifax:

A man who had carried on the practice of arsenic-eating for three or four years suffered from all the symptoms of arsenical cachexia. He sank under this practice, and after death the usual appearances of chronic poisoning by this substance were found. A chemical analysis showed only slight traces of arsenic in the liver, and none in the stomach.

Habit appears to have usually so little influence on this substance under the most careful medicinal use in this country that the author believed no medical practitioner had ever succeeded in causing a patient to take a lethal quantity, two grains at a dose. Hunt fixed the maximum dose at one grain (two drachms of Fowler's solution). In Roscoe's informant's case the man swallowed in two doses, on two successive days, a quantity of arsenic equivalent to *two ounces and a half* of Fowler's mineral solution, *i.e.*, sufficient to kill five adults. There is, however, a difficulty in assigning the alleged tolerance of this poison merely to *habit.* Roscoe quotes from Schäfer "a most important case of the administration of no less than 555 grains of arsenic to a horse in twenty-three days, without any evil effects being produced." It is not stated that the animal began to take arsenic in early life; and habit could have had but little influence in three weeks on the large quantity here given, even admitting that small doses were given at first, and that these were gradually increased. As no evil effects were produced, the only inference is that, by some speciality of organisation, arsenic was not a poison to this animal. There are on record several instances of human beings having recovered from very large doses (*vide infra,* "Poisoning by Arsenic").

Roscoe's pamphlet satisfactorily shows that symptoms of acute poisoning, gastro-enteritis, and death are sooner or later the results of the adoption of this dangerous practice in Styria. It would be difficult to persuade an English peasant, however ill educated, that he could safely put into his daily food a substance which he used for destroying vermin, or an Englishwoman that she could safely take, to improve her personal attractions, a mineral which pregnant women were in the habit of using to procure abortion.

The alleged impunity of the Styrians in the habitual use of arsenic may be occasionally quoted to explain the detection of the poison in a dead body or a motive for its purchase; but no scientific witness who has seen anything of the operation of arsenic in this country can allow these statements to influence his opinion of its effects on human beings.

The form in which the author knew the question of habit to be seriously raised in medical jurisprudence was this: whether, while the more prominent effects of a poison are thereby diminished, the insidious or latent effects on the constitution are at the same time counteracted. The answer is of some importance in relation to the subject of life insurance, for the concealment of the practice of opium-eating by a person whose life was insured has already (*vide* Vol. I., p. 751) given rise to an action in which medical evidence on this subject was rendered necessary. As a general principle we must admit that habit cannot altogether counteract the insidious effects of poisons, and that the practice of taking them is liable to give rise to disease or to impair health.

The whole question of the effects of arsenic-eating has, however, since been raised on the occasion of the trial of Mrs. Maybrick (*R.* v. *Florence Maybrick*, Liverpool Sum. Ass., 1889), when it was contended that the deceased, Mr. Maybrick, was an habitual taker of arsenic; but the evidence as to this was inconclusive (Guy's Hosp. Rep., 1889, xlvi. 307).

There can be no doubt that workmen in chemical factories do to a certain extent (probably a limited one) become accustomed to taking in with impunity quantities of poisons or noxious substances which would produce very serious symptoms in one not so habituated. Thus on the authority of Dr. Hill, of Woolwich, the editor is informed that at the chemical works at Silvertown the workmen are, to say the least of it, extremely careless in connection with cyanide of potassium. It accumulates on the beard and face, and quantities which would have a most serious effect upon ordinary individuals are apparently swallowed with impunity. Dr. Hill goes even further in regard to the habits of the workmen.

Apart from mineral poisons, tobacco, opium, and cocaine are good illustrations amongst vegetable products, alcohol and chloral amongst organic chemicals.

Such a point as habit has generally to be considered in connection with accidental poisoning by an overdose. It rarely crops up in homicidal cases; the Maybrick case is the most notorious example. In suicide the editor believes that a big dose is often taken with an utter carelessness as to results, without deliberate intent to destroy life (opium and chloral in heart disease, for instance). Evidence of such habit is usually easy to obtain, and throws considerable light on the case.

E. **Dose.**—This is too obvious to require much comment, but at the same time, though obvious, it is a point of the greatest importance. We are constantly prescribing drugs in small doses which in larger doses would prove very "noxious" and even poisonous. The medical jurist must accordingly be well posted in the doses of drugs, and especially must he be able to refer to doses which have actually proved fatal.

There can be no doubt that there are certain conditions of the system and its organs which appear to confer a power of tolerating large doses of drugs which under other conditions would prove poisonous. Thus persons labouring under tetanus and hydrophobia have taken, without producing dangerous symptoms, doses of opium which in health would have killed without fail: so too in delirium tremens doses of digitalis have been given such as would in health be certainly fatal, and similarly alcohol is given in disease in doses which would be very deleterious in health. Physiological antagonism (*vide* below, p. 337) may have something to do with the matter, but in many of such instances there can be no doubt that the explanation lies in alterations in absorption and excretion rate, to which we must now devote some attention.

F. **State of Stomach and Kidneys.**—These organs have such an important bearing on poisons in general and the effects of varying dosage in particular that rather full attention must be given to them. We have—

1. Disease in general checking the function of absorption from the stomach and excretion from the kidney.
2. Local disease of stomach or kidney causing vomiting or deficient absorption or excretion.
3. Effects of sleep on digestion or excretion.
4. Amount and nature of the contents of the stomach when the poison is taken, influencing action and time of action.

To understand the significance of the point under discussion the following idea must be borne in mind. A dose of non-irritant poison (corrosives and irritants are not included, their action belonging to a rather different category) taken into the stomach or injected hypodermically (in hypodermic administration the locality of injection corresponds to the stomach) may be divided not only theoretically, but practically, into three parts, which may be designated x, y, z (x being that part still left unabsorbed in the stomach or intestine or locality of the injection; z that part which has been excreted by kidneys, skin, lungs, or bowel; and y that part which has been absorbed and is still either in the blood or in contact with or within the tissue cells). The symptoms exhibited are not due to x nor to z, but almost entirely to y. In corrosives and irritants the symptoms are at first entirely due to x, but later may, and in many cases are (oxalic acid, phosphorus, etc.) due to both x and y. Now the rate of absorption from the stomach is a function of two variables: (1) the intrinsic power of certain substances to osmose through membranes; (2) the condition of the stomach wall; and similarly the rate of excretion from the kidneys (lungs, bowels, etc.) is also a function of the same two variables. In health (or rather in experiments on animals in health) a little information has been obtained with regard to the osmotic capability of certain substances which may be thought to exert no specially deleterious effect upon the absorbing or excreting cell in their passage through such cells, but we have no means of knowing how far and in what way poisons may affect these cells. Broadly speaking the ratio of rate of absorption to rate of excretion gives us a rough measure of y, not one perhaps of great practical value, though it may help us in treatment a little, but certainly one of great theoretical interest. It might, for instance, be raised for the defence of a criminal that the amount of poison found in the stomach (x) or in the tissues (y) was not sufficient to kill. The above consideration shows how such a defence may be met and the amount of bearing it has on the dose administered.

(1) **General Diseases.**—There can be no doubt that in acute pyrexial disease absorption from the stomach is reduced to a minimum, if not actually held in abeyance. The editor feels certain that the impunity with which ounce doses of the tincture of digitalis are administered in delirium tremens is owing largely to non-absorption; digitalis has also very certainly a small specific rate of absorption. The same argument may hold good for opium in tetanus, *vide* above. Chloral, alcohol and many soluble salts have *per contra* a high specific absorption rate, and the action of heroic doses of these, as administered in delirium tremens, trenches on the ground of physiological antagonism which will be mentioned later (pp. 337 *et seq.*). In apyrexial diseases, provided the stomach is healthy, the editor does not think much stress can be laid on variations in absorption.

On the other hand, a person very feeble from disease may succumb to a dose that is ordinarily quite safe. Antimony, for example, might thus kill by syncope, as it is a powerful depressant. Opium, again, should be avoided in severe lung affections, or used with great care. A knowledge of these facts is of importance in reference to charges of malpraxis when death has arisen from ordinary or extraordinary doses of medicines administered to persons labouring under disease (*vide* an inquest reported in the daily press on December 2nd, 1904, where the propriety of the dose of opium given in disease was called in question). In such cases another mode of treatment should be substituted, or a smaller dose than usual given, and its effects carefully watched. In some instances, however, full and large doses of powerful drugs have been recklessly given, and when a fatal result has followed, there has been a strong disposition to refer death to the supposed disease, of which, however, sometimes no trace could be found in the body.

It is not quite so clear that excretion from an otherwise healthy kidney is similarly affected by pyrexial disease. The well-known diminished quantity of urine in fevers may be due to increased excretion from the lungs, though it may be due to the evil effects of toxins in the blood on the secreting cells of the kidney.

(2) **Local Gastric Diseases.**—These are so frequently (forms of gastritis) associated with vomiting on the slightest (or no) provocation that the poison will probably depend mainly upon the item x for its ultimate effects (exhaustion), an important consideration in administering inappropriate food in alimentary diseases. In pyloric stenosis and conditions of atrophy and ulceration from cancer there can be no question that absorption is interfered with.

The likeness between this local disease and the symptoms of chronic irritant poisoning has probably had as a consequence the non-detection of many cases of crime, discovery only coming either by accident or a suspicious frequency in the manner of death—Palmer's case for instance, or Chapman's: as a matter of fact almost all great criminal poison cases have had to deal with arsenic or antimony as the means used when slow poisoning has been in question.

Local Disease of the Kidney.—In actual poisoning (criminal or accidental) the condition of the kidneys does not come so much into consideration as it does in those cases of illness where we are administering drugs in medicinal doses and care is required to prevent an undue increase in the item y above; on this account opium and mercury must be cautiously administered in known Bright's Disease, and a cumulative action is alleged against several drugs, but typically against digitalis. The editor would himself prefer to make a charge of carelessness against the administrator who, when giving drugs known to be slowly excreted, does not order a daily measuring of the urine that he may have an early warning of insufficient elimination. The condition of the kidneys does, however, now and again arise when we have managed to ward off the immediate effects of a poison and are hoping that the excretory organs may be able to deal satisfactorily with the quantity we have been unable to eliminate or neutralise; this holds typically in such cases as poisoning by cantharides, mercury, turpentine, carbolic acid, and a few other drugs. Now it has to be borne in mind that there is (1) the original health of the kidney, and (2) its health while it is attempting to pass these substances through its cells, to be considered, and it is quite possible for such damage to be done by the excretion that permanent disturbance may remain. To further discuss the matter here would lead too far into clinical as opposed to legal medicine.

(3) **Effects of Sleep.**—The admitted slowness of absorption from the stomach during sleep has to be remembered in cases where the

symptoms of poisoning have been delayed for some time, and it is found that for part or all the time the victim has been asleep.

(4) **Amount and Nature of the Contents of the Stomach.**—Facts clearly prove that the chemical interchanges between the extraordinary variable substances which are put into the stomach do not go on in quite the same manner as they do in a test-tube in the laboratory, though they may be approximately the same, for we use the principle in administering a direct antidote. However this may be, it is very certainly true that food prevents *contact* with the stomach wall to some extent, and thus diminishes in a degree the effects of some less soluble irritants ; at the same time *dilution* has to be considered when the stomach contains much liquid or bulky pultaceous contents; *absorption* is also influenced in some physiological (as opposed to the above merely physico-chemical) manner by the presence of food and by its preparedness for absorption. Arsenic, acids, alkalies and some other irritants are typical examples of poisons the action of which is thus hindered and delayed by the presence of a bulk of food, liquid or solid, in the stomach. *Per contra*, when the stomach is empty, more rapid and intimate contact with the mucous membrane, less dilution, and quicker absorption are all favoured; it is very easy to see the bearing of these factors on the question of the dose of a poison in comparison with the rapidity of its action.

G. **Concentration.**—This chiefly affects irritant poisons which, when concentrated, almost become corrosives. The acids and alkalies, for instance, when concentrated, will burn the mouth, gullet, and stomach, and a dose which would thus possibly lead to a fatal issue sooner or later may in weaker dilution be swallowed with impunity ; of drugs which act after absorption, concentration has *per se* no consequence ; it is the total dose, or rather the part absorbed (*y*), which is in question.

H. **Chemical Combination.**—This is principally a question of direct neutralisation, *q.v.*, but one must draw attention to the difference between certain chemical compounds amongst themselves and between them and the elements of which they consist. Take the compounds of mercury, for instance, calomel and corrosive sublimate, or the two iodides, how widely their doses differ; take hydrocyanic acid or any other organic poisonous body, we simply cannot compare its action with that of its elements, there is no comparison.

I. **Physical State** (Gas, liquid or solid).—This is principally a matter of the portal for entrance, or method of administration, and a question of the channel of absorption rather than one of the actual state of the substance. Poisonous gases such as CO_2 or even CO may be present in the stomach without harm in quantities far in excess of those which if admitted to the air passages would cause serious trouble. *Per contra* liquids and solids might and do produce much harm in the lungs, though little if placed in the stomach.

Perhaps here may be mentioned the fact that hard old pills will often enough pass unchanged through the alimentary canal. Keratin, again, is a substance (insoluble in the acid gastric juice, soluble in the alkaline contents of the small intestine) used to coat pills intended to become active only in the intestine ; a poison given in a keratin coat might have its action delayed several hours. *Vide* also *ante*, p. 306, where a berry of cocculus indicus still in its husk was very justly termed a poison.

These considerations on the circumstances influencing the action of poisons may appear a little prolix and commonplace, but they are very germane to the subject, for they enable the medical jurist to see the drift of, and to answer so far as explanation is possible, the following questions which a defending counsel is sure to put:

What was the actual cause of death?
Why was it poison and not disease?
What is the fatal dose of the alleged poison?
Why did the symptoms not occur at once, or why did they?
Why did they vary from the usual time of occurrence?
Was the dose a necessarily fatal one?

Many others, too, are likely to occur to a counsel in his endeavours to show:

(1) That death was not due to poison at all.

(2) That if so it was not the alleged poison, because (*a*) the symptoms did not occur at the usual time, nor (*b*) in the usual order.

Take the **time**, for instance, at which symptoms appear after swallowing a poison.

This question requires examination, because the more common poisons, when taken in fatal doses, generally cause death within definite periods of time. By an attention to this point we may, in some instances, be enabled to negative a charge of poisoning, and in others to form an opinion of the kind of poison which has been taken. In a court of law a medical practitioner is often required to state the usual period of time within which poisons prove fatal. It is to be observed that not only do poisons differ from each other in this respect, but that the same substance, according to the above circumstances in which it has been taken, may differ in the rapidity of its action.

A large dose of prussic acid, *i.e.*, from half a fluid ounce to an ounce of two per cent. acid, may destroy life in less than two minutes. In ordinary cases of poisoning by this substance a person dies—*i.e.*, all signs of life have commonly ceased—in from ten to twenty minutes: if he survives half an hour, there is some hope of recovery.

In the case of seven epileptics, accidentally poisoned by a similar dose of this acid in one of the Parisian hospitals, the first died in about twenty minutes, the seventh survived three-quarters of an hour.

Oxalic acid, one of the most energetic of the common poisons, when taken in a dose of from half an ounce to an ounce may destroy life in from ten minutes to an hour: if the poison be not perfectly dissolved when swallowed, it is a longer time in proving fatal.

The strong mineral acids, in fatal cases, destroy life in about eighteen or twenty-four hours.

Arsenic in the form of arsenious oxide or acid (white arsenic) operates fatally in from eighteen hours to three or four days. It has, however, in more than one instance, killed a person in two hours.

A woman of the name of Russell was tried and convicted (Lewes Sum. Ass., 1826) for the murder of her husband, by poisoning him with arsenic. The poison was detected in the stomach; but the fact of poisoning was disputed by some

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medical witnesses for this among other reasons, that the deceased had died *three* hours after the only meal at which the poison could have been administered to him.

The authority of Sir A. Cooper and others was cited to show that, according to their experience, they had never known a case of poisoning by arsenic to have proved fatal in less than seven hours. This may be admitted, but, at the same time, there was sufficient authority on the other side to establish that some cases had actually proved fatal in three or four hours. So far as this objection was concerned, the prisoner was properly convicted. In reference to the medical question raised at this trial, we may observe that two cases have occurred in which the individuals died certainly within *two hours* after taking arsenic; and several instances have been reported in which death has taken place in from three to four hours after the administration of this poison. It is quite obvious that there is nothing, so far as we know, to prevent arsenic from destroying life in an hour, or even within a shorter period. A case will be related in which death took place from arsenic probably within twenty minutes. (This is a very doubtful case.—Sir T. Stevenson.) These matters can be settled only by a careful observation of numerous cases, and not by any *à priori* reasoning, nor by a limited individual experience.

Opium, either as a solid or in the form of laudanum, commonly proves fatal in from six to twelve hours; but it has been known, in several instances, to destroy life in less than three hours; on the other hand, it has never been known to destroy life instantaneously or within a few minutes; those who survive the effects of this poison for twelve hours are considered to have a fair chance of recovery. This must be understood to be merely a statement of the average results, as nearly as we are warranted in giving an opinion; but the medical jurist will of course be aware that the fatal period may be protracted or shortened, according to all the circumstances above detailed.

In all instances of **sudden death** there is generally a strong tendency on the part of the public to suspect poisoning. They do not consider that persons may die a natural death *suddenly*, as well as slowly; or, as we shall presently see, that death may really take place slowly, and yet be due to poison. This prejudice often gives rise to the most unfounded suspicions of poisoning, and, at the same time, leads to cases of chronic or slow poisoning being frequently mistaken for natural disease. One of the means recommended for distinguishing narcotic poisoning from apoplexy or disease of the heart is the difference in the rapidity with which death takes place. Thus, apoplexy or disease of the heart may prove fatal either instantly or within an hour. The only poisons likely to operate with such fatal rapidity are prussic acid and nicotine. Poisoning by opium is commonly protracted for five or six hours. Thus, then, it may happen that death will occur with such rapidity as to render it impossible, under the circumstances, to attribute it to narcotic poison.

Chronic Poisoning.—When a poison destroys life rapidly, it is called a case of *acute* poisoning, to distinguish it from the *chronic* form, *i.e.*, in which death takes place slowly. Chronic poisoning is a subject which frequently requires medico-legal investigation. Most poisons, when their effects are not rapidly manifested, owing either to the smallness of the dose or to timely treatment, are capable of slowly undermining the powers of life and killing the patient by producing emaciation and exhaustion. This is sometimes observed in the action of arsenic, corrosive sublimate, and tartarated antimony. The characters of chronic poisoning have of late years acquired a special interest for the medical jurist. There is a difficulty about them which no accuracy of observation or judgment can surmount. The poison or poisons, if found in the dead body at all, must necessarily exist in fractional parts of a grain. This alone will be sufficient to allow a defending counsel to raise the question whether death has been caused by the poison, although it is quite consistent with medical experience that a person may die from chronic poisoning and little or none of the poison be found in the body after death.

In the case of Mrs. James (*R.* v. *Winslow*), not more than the tenth part of a grain was found in the whole of the tissues of the body; in the case of Isabella Banks (*R.* v. *Smethurst*), the quantity was small; while in the case of Mrs. Peters of Yeovil, examined by Herapath, *none* was found in the body, although this chemist had extracted a quantity of antimony from the urine of deceased less than nine days before her death, showing the possible importance of the part *z* (*supra*).

In this case Garland had also found antimony in the evacuations during life, and had referred the intermittent irritation of the stomach and bowels, from which deceased had suffered, to the secret use of this mineral. The jury returned a verdict that deceased had died from disease and that death was accelerated by some irritant (*Lancet*, 1860, 2, p. 119). On some trials for poisoning it has been a contested scientific question whether a person can die from poison and no trace of the poison remain in the body. Herapath's evidence in Peters' case not only proves the affirmative, but goes to show that antimony may act fatally and be entirely eliminated from the system in about a week (*Med. Times and Gaz.*, 1860, 2, pp. 190, 271, 317).

When only *traces* of arsenic, antimony, copper, phosphorus and a few other minerals are found, defending counsel may raise the question whether they are not natural constituents of the body or of certain articles of food; the recent discovery of arsenic in beer at Manchester and elsewhere has shown how many hitherto unsuspected sources of this element, and unsuspected channels of its admission to the body, there may be. It may, however, be positively stated that neither antimony, arsenic, copper nor lead are really natural constituents of the body, and if found even in the minutest traces an explanation of why they are found must be forthcoming.

In 1878 in France (Court of Assizes of the Seine) a chemist named Dauval was condemned to penal servitude for life for wife murder by poison. Extremely minute traces of arsenic were found in her body. In 1904, although discharged from the convict settlement, he applied for a revision of his case and sentence under the French law of 1895, which enables the Supreme Court to set aside a judgment and sentence in a criminal case, and order a new trial whenever a *fresh fact* is disclosed sufficient to possibly establish the innocence of the accused. It was alleged as such a "new fact" that arsenic might be normally present in the body, and so strongly did the judges feel that such was possible that they allowed a new trial, which, on the evidence, was favourable to the prisoner.

Several cases have come before our tribunals in which the facts connected with this chronic form of poisoning were of some importance. A case may be mentioned, that of *R.* v. *Wooler*, Durham Wint. Ass., 1855, in which it was proved that the deceased had been under the influence of arsenic, administered at intervals in repeated doses, for a period of about seven weeks before her death. She died from exhaustion and the secondary effects of the poison. In three other cases tartarated antimony was the poison selected. It was given in repeated doses, over different periods, and caused death by the specific effects of poisoning in a chronic form.

The case of Ann Palmer (Guy's Hosp. Rep., 1857); the case of M'Mullen (Liverpool Sum. Ass., 1856), in which a woman was tried and convicted for causing the death of her husband; and the case of *R.* v. *Hardman* (Lancaster Sum. Ass., 1857), in which a man was convicted of the murder of his wife, are cases in point.

In most cases murderers destroy life by administering poison in large doses; but in the instances referred to, small doses were given at intervals, a fact which, in some of them, led to a medical doubt of the real cause of the symptoms. The case of Isabella Banks (*R.* v. *Smethurst*, C. C. C., August, 1859) gave rise to a conflict of medical opinion respecting the cause of death.

Julius and Bird, who attended the deceased throughout her illness of about a month's duration, Todd, and the author, referred the symptoms and cause of death to chronic poisoning by antimony and arsenic, and in confirmation of this opinion traces of antimony were found by Odling and the author in the intestines after death. A small quantity of arsenic was also found in an evacuation passed by the deceased three days before her death. Tyler, Smith, Richardson, and others, referred the symptoms and appearances partly to pregnancy, and partly to a sudden attack of severe dysentery. The jury found the accused guilty, but upon the doubt raised respecting the cause of death, the accused was subsequently pardoned.

A similar question arose in *R.* v. *Winslow* (Liverpool Aut. Ass., 1860).

The prisoner was charged with the murder of a Mrs. James by administering to her small doses of antimony. The suspicion of Cameron, who attended deceased, was excited by the intermittent and violent nature of the vomiting, as well as by the extreme depression. Antimony was found in the urine and fæces by Edwards; and, after death, this substance was discovered, in small quantities, in the viscera, by Edwards, Miller, and the author. The deceased was at the time labouring under malignant disease of the cæcum, but it was alleged that the antimony had accelerated her death. The jury acquitted the accused. The examination of the bodies of the sister of deceased, as well as of two other members of the family, led to the discovery of antimony, also in small quantity, in the viscera of each; and from the nature of the symptoms preceding death, as well as the general healthiness of the organs, no doubt was entertained by the medical witnesses that all these persons, members of the same household, had died from the effects of antimony administered at intervals in small doses. A set of cases somewhat similar was brought to light by certain inquests on exhumed bodies at Bilston (December, 1871). Three children in a family died at different times, under similar symptoms. Hill found antimony in two of the bodies, and the body of a third child was exhumed after two months' burial, and antimony was also found in it. It appears that this child died on October 10th, and its death was registered on the 13th of that month as death from "asthenia," and "gastric fever" "six days." They all received medical attendance, and their names, it is stated, were entered in some burial club.

In the case of Chapman, or Klosowski (C. C. C., March, 1903), Maud Marsh, the victim, had been an inmate of Guy's Hospital for what was probably (in the light of after events) illness due to antimonial poisoning without discovery of the crime; the murderer's previous victims had been buried in 1897 and 1901 on ordinary certificates (the case is given in full on pp. 356 *et seq.*).

The occurrence of such cases as these suggests grave reflections on the insecurity of life when poison is used with skill and cunning, and they demonstrate the inefficiency of the present system of registering causes of death. They show that medical men, in signing certificates, do not sufficiently inquire into the nature of the fatal illness, or the cause of death, but this is an evil which admits of an easy remedy. The public have much more to dread in the fact that, even in plain cases of poisoning, some physicians of experience and repute have been unable to discriminate the symptoms from those of natural disease. Thus in 1889 the bodies of three persons were exhumed, and the viscera examined by Dr. Stevenson. All died of arsenical poisoning, and these persons were inmates of a house at Deptford, in which several other deaths had occurred within the space of two years. They were nearly all attended during their last illness by one medical man, in whose mind no suspicion of foul play had apparently arisen.

Again, in the notorious case of William Palmer, one physician who appeared for the defence affirmed that the symptoms under which Cook died were those of angina pectoris ; while another physician, also employed for the defence, assigned death to epilepsy with tetanic complications. The witnesses came forward as experts to maintain these views. In reference to the death of Ann Palmer, which was caused by doses of antimony, the solid sulphide of this metal was found in the stomach after death, while the metal itself pervaded the whole of the tissues. A respectable physician, with only a superficial knowledge of the real facts of the case, wrote a pamphlet to prove that this woman had died from an attack of cholera. If these persons had been called in to attend these two victims of secret poisoning while living, it is quite obvious that they would have had no suspicion of poisoning, and that they would have respectively certified that death was caused in the one case by angina pectoris or epilepsy, and in the other by cholera. They would thus have effectually screened, under erroneous medical certificates, the acts of a man who is admitted to have been the greatest criminal of the age. If physicians of some standing, and professed experts, can thus overlook ordinary cases of poisoning, it is not surprising that general practitioners, who have not given special attention to the subject of toxicology, should fall into the error of granting erroneous medical certificates, and of certifying that death from arsenic or opium was due to cholera, convulsions, or apoplexy.

SUB-SECTION C.—DIAGNOSIS OF POISONING.

We now proceed to consider the evidence of poisoning in the *living* subject. To the practitioner the diagnosis of a case of poisoning is of great importance, as by mistaking the symptoms produced by a poison for those arising from natural disease, he may omit to employ the remedial measures which have been found efficacious in counteracting its effects, and thus lead to the certain death of the patient. To a medical jurist a correct knowledge of the symptoms furnishes the chief evidence of poisoning, in those cases in which persons are charged with the malicious and unlawful administration of poison. The symptoms produced during life constitute also an important part of the evidence in those instances in which a poison proves fatal.

Poisoning, like other forms of violence of which the law takes notice, occurs either Accidentally, Suicidally, Homicidally.

So far as diagnosis is concerned, the first two classes are not likely to give rise to so much trouble as the third, for almost invariably conclusive evidence as to the nature of the case is only too much to the fore. The urgent message to "come at once," the number of people simultaneously attacked, etc., are very familiar occurrences; nevertheless there are many diseases with incidents in their course which may closely resemble poisoning. Moreover, it is the especial business of a murderer to make the case resemble one of natural illness (or at least of suicide). Luckily for the ends of justice, he is seldom sufficiently skilled or sufficiently patient to carry this out to the bitter end.

Speaking very broadly, we may say there is no *single symptom* of poisoning, and in fact no special definite grouping of symptoms, which is pathognomonic or absolutely characteristic of poisoning; but, on the other hand, there is no poison which gives us the finer shades of difference from day to day and the changing aspects of disease, and no disease which gives all the features of poisoning in number and especially in sequence. The closest likeness to disease is given us by ptomaine poisoning, and the closest likeness to poisoning perhaps by uræmia in its acutest phases; but except for the associated circumstances of the means by which the poison is introduced to the body these are really illustrations of identicals, and they scarcely invalidate the above generalisation.

The following are some of the principal individual points which in any given case should make one suspicious of poisoning and lead one to make particular search for their meaning:

1. **In Poisoning, the Symptoms appear Suddenly.**—It is the common character of most poisons, when taken in the large doses in which they are usually administered with criminal intent, to produce serious symptoms, either immediately or within a very short period after they have been swallowed. Their operation, under such

circumstances, cannot be suspended, and then manifest itself after an indefinite interval; although this was formerly a matter of universal belief, and gave rise to many absurd accounts of what was termed *slow* poisoning.

The symptoms of poisoning by nicotine, prussic acid, oxalic acid, or the salts of strychnine, appear immediately, or generally within a few minutes after the poison has been swallowed. In an exceptional case, in which the dose of prussic acid was small and insufficient to produce death, the poison was supposed by the patient not to have begun to act until after the lapse of fifteen minutes (*Edin. Med. and Surg. Jour.*, vol. 59, p. 72). The symptoms caused by arsenic and other irritants, and, indeed, by all poisons generally, are commonly manifested in from half an hour to an hour. It is rare that the appearance of symptoms is protracted for two hours, except under certain peculiar states of the system. It is said that some neurotic poisons, such as the poisonous mushrooms, may remain in the stomach twelve or twenty-four hours without giving rise to symptoms; we do not know upon what authority this statement is made, but it is obvious that, if true, it is a matter of (lack of) digestion, the mushroom itself not being a poison until after absorption. In this connection it must not be forgotten that tetanus, acute mania, cholera, perforation of a gastric or other intestinal ulcer, epilepsy, or uræmia, may likewise commence very suddenly and closely simulate the onset of poisoning.

2. **The Symptoms appear during a state of Health.**—Symptoms of poisoning manifest themselves in a person while in a state of *perfect health*, without any apparent cause. This rule is of course open to numerous exceptions, because the person on whose life an attempt has been made may be actually labouring under disease; and under these circumstances the symptoms may be so obscure as often to disarm all suspicion. In fact, in almost all the *causes celèbres* of multiple criminal poisoning this has been the case with the earlier victims. In the case given under "Exhumation" (Vol. I.) the deceased was attended shortly before her death by Mr. Rafter, who found her suffering from pneumonia. He was surprised at her death, but certified it as due to pneumonia; *it was carefully concealed from him that the deceased suffered from vomiting, purging, and intense abdominal pain.* When poison is secretly given in medicine, a practitioner is very liable to be deceived, especially when the disease under which the person is labouring is of an acute nature, and has been attended by symptoms of disorder in the alimentary canal. Several cases of poisoning have occurred in which arsenic was criminally substituted for or mixed with medicine, and given to persons while labouring under a disorder of the bowels. We are, however, justified in saying, with respect to this character of poisoning, that when, in a previously healthy person, violent vomiting and purging occur suddenly and without any assignable cause, such as pregnancy, disease, or indiscretion in diet, to account for them, there is strong reason to suspect that irritant poison has been taken. When the person is already labouring under disease, we must be especially watchful on the occurrence of any sudden change in the character or violence of the symptoms, unless such change can be easily accounted for on common or well-known medical principles. In most cases of criminal poisoning we

meet with alarming symptoms without any obvious or sufficient natural causes to explain them. The practitioner will of course be aware that there are certain diseases which are liable to occur suddenly in healthy people, the exact cause of which may not at first sight be apparent; strangulation of a hernia, perforation of a gastric ulcer, cerebral hæmorrhage may be taken as the most typical illustrations; therefore this criterion is only one out of many on which a medical opinion should be founded.

3. **In Poisoning the Symptoms appear soon after a Meal, or soon after some kind of Food or Medicine has been taken.**—This is by far the most important character of poisoning in the living subject. It has been already stated that most poisons begin to operate within about an hour after they have been swallowed; and although there are a few exceptions to this remark, yet they occur under circumstances easily to be appreciated by a practitioner. Thus, then, it follows that, supposing the symptoms under which a person is labouring to depend on poison, the substance has most probably been swallowed, either in food or medicine, from half an hour to an hour previously. It must be observed, however, that cases may occur in which the poison has not been introduced by the mouth (*vide* above, "Mode of Administration"). Oil of vitriol and other corrosive liquids have been thrown up the rectum in injections, and have thus caused death; the external application of arsenic, corrosive sublimate, and cantharides to ulcerated surfaces has destroyed life. In one case, arsenic was introduced into the vagina of a female, and she died in five days under all the symptoms of arsenical poisoning (Schneider, "Ann. der ges. Staatsarzneik.," 1, 229). Such cases are rare, but, nevertheless, the certainty that they have occurred, where their appearance could hardly have been anticipated, shows that in a suspicious case a practitioner should not deny the fact of poisoning merely because it may be proved that the person could not have taken poison in the usual way, by the mouth. Again, persons may be destroyed by the vapours of ether, chloroform, prussic acid, or other powerful volatile poisons, introduced into the body through the lungs. Such a mode of suicide, or murder, might disarm suspicion, from the fact of no noxious material being found in the stomach.

Let us suppose, however, the circumstances to have been such that these secret means of destruction could not have been resorted to, and that the substance is one of those most commonly selected by a murderer, such as arsenic, tartar emetic, oxalic acid, or corrosive sublimate, then we may expect that this character of poisoning will be made evident to us, and that something must have been *swallowed* by the patient shortly before the alarming symptoms appeared. By observations attentively made, it may be in our power to connect the appearance of the symptoms with the use of a particular article of food, and thus indirectly lead to the detection of a criminal. Supposing that many hours have passed since food or medicine was taken by the patient, without any effect ensuing—it is probable that the symptoms are due to natural causes, and not to poison.

Since the above was written by Dr. Taylor we have learnt to coat pills or capsules with a substance known as keratin, which is insoluble in the acid contents of the stomach. With such a coating, then, a poison might be given and not act till several hours had elapsed, as the keratin only dissolves when the contents of the bowels are alkaline.

When symptoms resembling those of poisoning speedily follow the ingestion of food or medicine, there is, however, reasonable ground for suspicion; but caution should be observed in drawing inferences, since the most extraordinary coincidences sometimes present themselves.

Delay in the onset of symptoms occasionally occurs in phosphorus poisoning if the dose be small, and in food poisoning too, which latter may be explained by the difference in the nature of the poison (*vide* later under "Poisoning by Food").

The substitution of poisonous mixtures for medicinal draughts or powders is by no means unknown, although it might be supposed to indicate a degree of refinement and knowledge not commonly to be found among criminals. Medical practitioners are thus apt to be imposed upon, and the following case, related by a deceased judge, will serve as a caution.

> An apothecary prepared a draught, into which another person put poison, intending thereby to destroy the life of the patient for whom the medicine was prescribed. The patient, not liking the taste of the draught, and thinking there was something suspicious about it, sent it back to the apothecary, who, knowing the ingredients of which he had composed it, and wishing to prove to his patient that he had done nothing wrong, drank it himself, and died from the effects. He was thus the unconscious agent of his own death; and though the draught was intended for another, the party who poisoned it was held guilty of murder.

On the other hand, the occurrence of symptoms resembling those produced by poisoning, soon after food or medicine has been taken, may be a pure coincidence. In such a case, poison is always suspected by the vulgar; and it will be the duty of a medical jurist to guard against the encouragement of such a suspicion, until he has strong grounds to believe it to be well founded. No public retractation or apology can ever make amends for the injury which may in this way be inflicted on the reputation of another; for those who hear the accusation may never hear the defence. In all such cases, a practitioner may entertain a suspicion, but, until confirmed by facts, he should avoid *expressing* it or giving it publicity. When death is not a consequence, it is difficult to clear up such cases, except by the aid of a chemical analysis; but this, as we know, is not always available or possible. If death ensue, the real cause is usually apparent, and a suspicion of poisoning is thus often removed by an examination of the body.

In cases of chronic criminal poisoning suspicion is often first aroused by the *repetition* of such an incident as the above, many patients may be sick once after a dose or a meal, but this excites probably no suspicion, nor need it do so, but if they are repeatedly sick we may with justice suspect some criminal intent on somebody's part.

4. **In Poisoning, when several partake at the same time of the same Food or Medicine (mixed with Poison), all suffer at approximately the same Time from approximately the same Symptoms.**—This character of poisoning cannot always

be procured; but it furnishes good evidence of the fact when it exists. Thus, supposing that after a meal taken by several persons from the same dish only one suffers, the suspicion of poisoning is considerably weakened. The poisoned article of food may be detected by observing whether they who suffer under any symptoms of poisoning have partaken of one particular solid or liquid in common. In a case of accidental poisoning at a dinner-party a medical man who was present observed that those who suffered had taken port-wine only; the contents of the bottle were examined, and found to be a saturated solution of arsenic in wine. In general, considerable reliance may be placed upon this character, because it is improbable that any common cause of disease should suddenly attack with violent symptoms of a similar kind many healthy persons at the same time, and within a short period after having partaken of food together. We must beware of supposing that, when poison is really present, all will be attacked with precisely similar symptoms; because there are many circumstances which may modify their nature and progress. In general that person who has partaken most freely of the poisoned dish will suffer most severely; but even this does not always follow. There is a well-known case, recorded by Bonnet, where, among several persons who partook of a dish poisoned with arsenic, they who had eaten little and *did not vomit* speedily died; while others who had partaken largely of the dish, and had in consequence vomited freely, recovered. This is easy to understand, for retention in the stomach of the poison meant an increase in the portion ("y" above) absorbed, while free vomiting would remove the bulk of the poison.

It is well to bear in mind, in conducting these inquiries, that symptoms resembling those produced by irritant poison may be sometimes traced to *food*. Meat rendered unwholesome by disease or decay, pork, bacon, sausages, cheese and bread, as well as certain kinds of shell-fish, may give rise to symptoms of poisoning, and even cause death. Such cases may be regarded as poisoning by animal or vegetable irritants. All the characters above described, as indicative of poisoning, may be observed, and the difficulty of forming an opinion is often increased by the fact that some of the persons attacked may have previously partaken of the same kind of food without inconvenience. Instances of this form of poisoning are unpleasantly common; brawn at Oxford, pork pie at Derby, ham at Nottingham, aërated bread at Christ's Hospital (750 out of 800 boys attacked with diarrhœa in 1868), have all caused outbreaks of this nature (*vide infra*, "Food Poisoning").

It was just now remarked that there is no disease resembling poisoning which is likely to attack several healthy persons at the same time and in the same manner. This is undoubtedly true as a general principle, but the following case will show that mistakes may occasionally arise even under these circumstances. It occurred in London during the prevalence of the malignant cholera in the year 1832.

Four of the members of a family, living in a state of great domestic unhappiness, sat down to dinner, apparently in good health; some time after the meal, the father, mother, and daughter were suddenly seized with violent vomiting and purging. The evacuations were tinged with blood, while the blueness of the skin, observed in cases of malignant cholera, was absent. Two of these persons died. The son, who was known to have borne ill-will against his father and mother, and who suffered no symptoms on this occasion, was accused of having poisoned them. At the inquest, however, it was clearly shown by the medical attendant that the deceased persons had really died of malignant cholera, and there was no reason to suspect that any poison had been administered to them.

In this instance it will be perceived that symptoms resembling those of irritant poisoning appeared suddenly in several individuals in perfect health, and shortly after a meal. We hereby learn that the utility of any rules for investigating cases of poisoning depends entirely on the judgment and discretion with which they are applied to particular cases.

5. **Course of the Symptoms.**—In practically all accidental and suicidal cases the course of the symptoms is either steadily down hill to death or equally steadily up hill to health; phosphorus is the principal exception that is not obvious at first sight; the after effects of corrosives and a few of the mixed class that act locally and remotely must also be remembered.

In skilled homicidal poisoning there may be ups and downs in the symptoms, but these from their nature (probably irritants) will rouse suspicion. It is equally true, of course, that some diseases have a somewhat similar course, and especially the ones (such as acute gastritis) that might at first sight be mistaken for poisoning. The point is, however, to be remembered in suspicious cases.

6. **The Discovery of Poison in the Food taken, in the matters Vomited, or in the Excretions.**—One of the strongest proofs of poisoning in the living subject is the detection of poison by chemical analysis, either in the food taken by the person labouring under its effects, or in the matters vomited, or, after the lapse of a few hours, in the urine, or, if of a vegetable nature, by a microscopical examination. The evidence is of course more satisfactory when the poison is detected in the matters vomited, and more especially in the urine (*vide infra*) than in the food; because this will show that it has really been taken, and it will or may readily account for the symptoms. If the vomited matters have been thrown away, we must examine the remains of the food of which the patient may have partaken. Should the results in both cases be negative, and no trace of poison be found in the urine, it is probable that the symptoms were due to disease.

In the investigation of a case of poisoning in a living subject, a medical jurist must remember that poisoning is sometimes *feigned*, and sometimes *imputed*. It is easy for an artful person to put poison into food, as well as to introduce it into the matters vomited or discharged from the bowels, and to accuse another of having administered it. There are few of these accusers who go so far as to swallow poison under such circumstances, as there is a great dread of poisonous substances among criminals; and it will be at once apparent that it would require a person well versed in toxicology to feign a series of symptoms which would impose upon a practitioner at all acquainted with the subject. In short, the difficulty reduces itself to this:—What inference can be drawn from a chemical detection of poison in food? All that a medical man can say is, "poison is or is not present in a particular article of food": he must leave it to the authorities of the law to develop the alleged attempt at administration. If the poison has been actually administered or taken, then we should expect to find that the person had suffered from the usual symptoms. The absence of these symptoms would be a strong fact against the alleged administration. The detection of poison in the matters vomited affords no decisive proof that it has been swallowed, except under two circumstances—1st. When the accuser has previously laboured under the usual symptoms of poisoning, in which case there can be no feigning, and the question of imputation is a matter to be established by general evidence. 2nd. When the matters are actually vomited into a *clean vessel* in the presence of the medical attendant himself, or of some person on whose testimony perfect reliance can be placed. The detection of absorbed poison in the *urine* or *saliva* furnishes a clear proof that poison has been taken, that it has passed into the blood, and has been subsequently eliminated by the kidneys or the salivary glands.

When poison is discovered mixed with food in the stomach it does not necessarily follow that it has been administered in that particular article of food. Should the person have partaken of liquid food, such as milk or gruel, subsequently to the swallowing of poison, these fluids will necessarily acquire a poisonous impregnation from that already contained in the stomach. The patient may have taken the poison in one kind of food, when another and an innocent description of food might thus inadvertently be pronounced to have been the vehicle (see the case of Ann Merritt, *London Med. Gaz.*, August 16th, 1850, 46, 291).

7. **No Poison Found.**—Throughout the section dealing with the individual poisons there will frequently be found cases in which no trace of poison has been found on exact analysis, although from other circumstances it was almost or quite certain that poison was the cause of death or illness; it is therefore necessary that the position should be examined.

There are obviously at least three possible explanations of such a result:—

1. *The whole case may have been misunderstood.* We have already, in several connections, drawn attention to the occasional similarities, and even identity, between poison and disease, and the negative finding must be allowed due weight in balancing up the probabilities of the case. To completely analyse all possible circumstances of this nature is obviously impossible to anyone; we can only draw attention to the possibilities.

2. *The poison may have been eliminated by vomiting or other means, or neutralised.* In corrosives and irritants associated with much vomiting the position is obvious, and emphasises the necessity of saving all possible vomit, etc., and also of looking for salts of acids, as well as the free acids, though the immediate local changes in the stomach, in the shape of inflammation, etc., will be strong corroboration (or negation). In considering the other channels of elimination it must not be forgotten that a poison may start processes which can proceed after the poison, or exciting cause, has ceased to act, and hence a person may die some time after the poison was administered, from what is apparently disease. A gastritis, for

instance, or a nephritis; under the headings of antimony, arsenic, etc., will be found cases of the former, and the editor has recently had a case in which lead was almost certainly the cause of cirrhotic kidneys (fatal), though none could be found on analysis.

3. *The analysis may have been faultily performed.* This may be due to circumstances over which the analyst had no control, *e.g.*, the wrong material sent for analysis, etc., or to circumstances over which he would have had control had he been more skilled. This latter consideration is one which shows the importance of having the most skilled assistance possible to perform such delicate work, but, at the same time, it must be remembered that there are still any number of substances which may be fatal to a human being if they gain access to his body, and which are, as yet, quite beyond the reach of chemical detection and identification—the precipitins, the lysins, the toxins of microbes are illustrations which occur to the mind at once. For the non-discovery, if present, of the ordinary alkaloids, etc., the modern analyst has nobody but himself to blame, and he should not undertake the work unless competent.

The following paragraphs are taken by the editor from the pages of the author dealing with arsenic, but their applicability to other poisons makes the present position much more suitable for their insertion.

In estimating dosage and quantities, for use in medico-legal cases, it is important, in reference to the presence of absorbed arsenic in the *tissues*, to observe that it may be found in them at an early period, when it is either absent or only doubtfully present in other parts, such as the alimentary canal.

A man died within *four hours* after he had been attacked with symptoms of poisoning by arsenic. Arsenic was found in small quantity in the stomach, duodenum, and rectum. It was also detected in the liver and spleen; and the proportion found was greater in the latter than in the former organ.

A man died from the effects of arsenic in the most acute form, soon after his admission into Guy's Hospital. He had swallowed a large dose of the poison in water. He was brought to the hospital, and died soon afterwards. Barely *three hours* could have elapsed from the time at which the poison was taken until his death. There were the usual appearances in the stomach, and gritty portions of arsenic mixed with coagulated masses of mucus and false membrane were found in the contents. The intestines were inflamed, and portions of arsenic were discovered as low as the cæcum. Arsenic was found abundantly in the stomach, and a comparatively large quantity of the poison was detected in half an ounce of the dried liver, as well as in the spleen and kidney.

Hence it is obvious that the poison may be rapidly absorbed and copiously deposited within *three* hours, the quantity thus found depending apparently on the dose taken.

In the case of the Atlee family, in 1854, the body of the mother was exhumed after a month. Arsenic was *not* found in the *stomach* nor *bowels*, but it was readily detected in a small portion of the *liver*. The poison had probably been taken several days before death.

The fact is of considerable importance in relation to a medical opinion of the presence or absence of poison in a dead body. It is clear, from the above cases, that an opinion might be erroneous unless the liver or spleen had undergone a chemical examination. Usually the liver contains half a grain up to a grain or two of arsenic, when death occurs within forty-eight hours. In preserving viscera for analysis, a portion of the liver, or better the whole organ, should therefore always be set apart for examination. If the person has lived fifteen or sixteen days after having taken the poison, no trace may be found in the tissues nor in any part of the body. Orfila long since expressed this opinion from his experiments on animals; its correctness has been strikingly confirmed by the case of Dr. Alexander, who died in *sixteen days* from a large dose of arsenic taken by mistake in arrowroot. Geoghegan found no trace of the poison, either absorbed or unabsorbed, in any part of the body which he examined (*Med. Times and Gaz.*, 1857, 1, p. 389). It is the more necessary that the fact of entire elimination should be remembered, because it has been impressed on the public mind that no person can have died from poison except the poison be present in the body after death. If this is untrue with respect to arsenic, it is necessarily untrue with regard to poisons less easy of detection in minute quantities.

In the case of *R.* v. *Williams* (South Wales Circuit, July, 1863), a woman was charged with the murder of her husband by administering to him arsenic. The evidence left no doubt that deceased had suffered from the usual symptoms of poisoning, namely, inflammation of the stomach and bowels, numbness of the limbs, and other symptoms. For some days before the deceased's death, owing to his food having been prepared for him by his daughter, the symptoms abated; but he ultimately died from exhaustion on the fifteenth day. Herapath examined the viscera, and found no arsenic. Neither in his reading nor in his experience had he known arsenic to have been detected fifteen days after its administration. As no poison was discovered in the body, the prisoner was acquitted on the charge of murder, but found guilty of the intent (*Lancet*, 1863, 2, p. 47).

Tidy was of opinion that arsenic may be found in the bones months after its administration. In the case of Soufflard, a large dose of arsenic had been taken; but according to Legroux, no trace of the poison existed in the stomach nor in the ulcerated portions of the bowels (*Union Méd.*, June 30th, 1850). Otto met with a case of death from arsenic within twenty-four hours, with the usual symptoms and appearances, but no arsenic could be found in the contents of the stomach. The liver and other organs were not examined (Horn's *Vierteljahrsschr.*, 1865, 1, 175).

SUB-SECTION D.—WHAT TO DO IN CASES OF POISONING.

This has three divisions, viz. :

A. Generally, as a medical man entrusted with the care of the health of others.

B. Clinically, in undoubted cases, equivalent to treatment.

C. As a medical jurist, to convict the guilty, or clear the innocent from suspicion.

A. Generally.

When treating, or called upon for the first time to treat, a case of illness, a medical man's mind must be in one of three conditions :

(*a*) A state of happy ignorance, one totally unaware of the necessity of thinking of poison.

(*b*) A state of certainty that it is a case of poison or of disease.

(*c*) A state of suspicion that it may be poison.

(*a*) The state of **happy ignorance** will commonly be dispelled by rumour or gossip, or perhaps more suddenly by a coroner's order for a post-mortem examination or an exhumation order from the Home Secretary. It need not be further discussed here, except to emphasise the advice to all medical men to try to keep in writing as full notes of all their cases as time and circumstances will permit, so that when faced with one of the above crises they may have at least a good basis to work upon.

(*b*) The state of **certainty** of disease has no interest for us here, and the certainty of poison will be considered later.

(*c*) The state of **suspicion** is one of very great delicacy and difficulty. There are three things which should be done at once. First, get some of the urine (*take care that it is the patient's urine*) or vomit, or of both, and submit the specimens to a careful analysis, sending them to a reputable analyst. Such a course, if at all practicable, is better than analysing it for oneself, because corroborative evidence from an independent witness, is thus obtained in one direction or the other. It is very easy for a medical man to obtain such specimens as a rule, because they are looked upon as things he would naturally wish to examine for clinical purposes. Second, insist upon having a consultation with another practitioner—for choice one of considerable standing, of strong character, reliable and friendly, or at least absolutely unbiassed—and submit to him your suspicions under seal of professional secrecy, and discuss the matter thoroughly. Third, if circumstances will in any way permit it, obtain two reliable nurses of your own choosing, one for day and one for night duty, and give them strict instructions to administer themselves everything in the shape of medicine and food and to allow no one to be with the patient alone; you must use your discretion as to how much of your suspicions you will communicate to the nurses, and for this very reason I say nurses *of your own choosing*, for it is obvious that the more you can tell them of the exact observations you require, the better and more loyal assistance will they be able to render you.

Your own observations, coupled with the information you will have obtained from the above procedure, will nearly certainly bring your suspicions to a head in one direction or the other. If you find no possible corroboration of them you are bound in honour to dismiss them for the time and wait for further developments; if on the other hand you do obtain such corroboration as converts suspicion into certainty, a very delicate position indeed may, or rather will, arise. "Shall I allow the patient to stop where he is?" is the first obvious dilemma: to remove him is certainly the best possible thing to do, or to banish the guilty party (if found). But either course may be impracticable; so your next question must be, "Whom shall I speak to?" You *must* take *some* steps to prevent a fatal termination (I am of course assuming that it is not a case in which one large dose has been administered either with fatal or non-fatal result), and you have your choice of informing:

1. **The Victim himself.**—If he (or she) be an adult and possess a good deal of strength of will and retain his (or her) mental faculties, it is easy to imagine circumstances under which this is the best course to pursue, for you may possibly get from the patient power to act vigorously. If the victim be a child or person permanently or temporarily (by the illness) *non compos mentis*, it is quite obvious that telling the victim is useless.

2. **A Member or Members of the Family.**—This, of course, depends entirely upon who they are, their peculiar characteristics, their strength of character, etc.

3. **The Suspected Person.**—This is often a good plan in order to avoid a scandal or a catastrophe, though this latter event might even be hurried by such procedure; the communication must obviously be done in private, or if in public the medical man must have very strong grounds for accusing one particular person.

4. **The Police.**—Here one must always remember that a doctor is or should be the confidential friend of his patients, at least so far as professional matters are concerned, and police and detective work form no proper part of his original duties. One would say, therefore, exhaust the diplomatic methods before resorting to the police. Every case of even chronic poisoning is not necessarily criminal; it may be accidental, a possibility which must be excluded before taking such a positive step as informing the police, at any rate in non-fatal cases—of course in fatal ones the coroner *must* be at once informed. On the other hand, such cases usually are crimes of the very deepest dye, and in bringing such to the notice of the police there is no need to consider the feelings of the scoundrels who would perpetrate such horrors. At

the same time it is very necessary to be sure of good grounds for accusation, otherwise a medical man may find himself let in for a very harmful trial for libel or defamation of character. Dr. Taylor remarked on this subject in former editions of this work. When a practitioner is aware of a case of *poisoning*, it is necessary that he should know to what points he ought to give his attention. Every effort should be made by him to save life when the individual is living; but while engaged in one duty, it is also in his power to perform another, supposing the case to be one of *suspected* criminal poisoning, namely, to to note down many circumstances which may tend to detect the perpetrator of a crime. There is no person so well fitted to observe these points as a medical man; but it unfortunately happens that many facts, important as evidence, are often overlooked. The necessity for observing and recording them is not perhaps generally known. A medical man need not make himself officious on such occasions, but he would be unmindful of his duty as a member of society if he did not aid the cause of justice by extending his scientific knowledge to the detection of crime. It is much to the credit of the medical profession that the crime of murder by poisoning—a form of death from which no caution or foresight can protect a person—is so frequently brought to light by the announcement of suspicious facts of a medical nature to magistrates and coroners; and on several occasions the highest compliments have been passed by judges on medical practitioners who have been thus indirectly the means of bringing atrocious criminals to the bar of justice.

In non-fatal cases of suicidal poisoning the doctor's position is an extremely delicate one. On the one hand, he may be placed in the position of compounding a felony if he holds his tongue; on the other hand, by reporting the case he may raise such a scandal as may mean ruin not only to himself, but to his patient and his family. There can be no doubt that the strictly correct attitude is to report the matter; but probably many such cases are hushed up without material harm to the community, and even if they come to an inquiry, juries are likely to lean to a possible verdict of accidental poisoning.

The Huddersfield poisoning case, Leeds Ass., 1896, is an excellent illustration of how a medical man should act, for it was owing to the sagacity of Dr. Demetriadi that the case did not end in murder (*Lancet*, 1, 1896, p. 566).

B. CLINICALLY, EQUIVALENT TO TREATMENT.

When face to face with an undoubted case of poisoning, immediate treatment must be the first and only concern. Let all other considerations be for the moment placed on one side. Murrell's "What to do in Cases of Poisoning" is an excellent book to have at hand. Here only the general principles of treatment will be dealt with.

The first very obvious point is to—

1. **Empty the Stomach.**—This applies to all cases (provided that there is time to do anything) where the poison has been taken by the mouth. The means for doing it are—

(*a*) By the stomach-pump. Obviously contra-indicated in corrosives from danger of tearing, and to be used with great caution in irritants.	(*a*) Be careful to pour some water into the stomach before pumping out the contents, that the tube may not come into too close contact with the walls, and also that the water may act mechanically in bringing away the "noxious substance" as well as chemically by dissolving it.
(*b*) Emetics:	
Sulphate of zinc.	Is fairly prompt; ʒss. may be given at once and repeated in a quarter of an hour. It is not very depressing, but if emesis does not occur is apt to be somewhat irritating; and may have after-effects of its own of an unpleasant character.
Ipecacuanha.	Is very useful, 20 to 30 grains of the powder or from ʒii. to ʒvi. of the vinum, and repeat. Is somewhat depressing, but if emesis do not occur it has no other special deleterious effect.
Mustard and water.	An excellent emetic because so commonly found in every house, and is rather stimulating than depressing. A tablespoonful of the powder may be stirred in a tumbler of water and swallowed rapidly.
Salt and water.	Also excellent used like mustard.
Ammonium carbonate.	Not so efficacious, but is a stimulating emetic; 15 to 30 grains may be given.
Apomorphine.	It is extremely useful in many cases because it is an indirect emetic, *i.e.*, acts through the nervous and vascular systems. It is given by hypodermic injection, and so may be used when swallowing is impossible, and even in states of unconsciousness. Its drawback is that it is very depressing; $\frac{1}{10}$ to $\frac{1}{12}$ of a grain is the maximum dose to give at first; it may be repeated in half an hour if necessary.

Tartar emetic. Sulphate of copper.	These two should be avoided unless it is impossible to get any others. They are objectionable on two grounds. Firstly, they are too depressant for general use, and, secondly, they are liable to interfere with analysis of the contents of the stomach. For the sulphate of copper almost always contains traces of arsenic, and naturally tartar emetic contains antimony. They have no counterbalancing good qualities unless they (or one of them) happen to be the only available emetics.

2. **Neutralise what remains in the Stomach.**—This neutralisation may be of either a direct chemical nature or of a mechanical or physico-chemical nature. The commoner illustrations are—

Alkalies neutralise acids by direct chemical action.

In this illustration there is a caution to be given, viz., it is safer to give a little weak liquor, the hydroxides (Am, Ca, Na, Mg, K), rather than the respective bicarbonates or carbonates, because of the possible risk of blowing up and bursting the stomach with the liberated carbonic acid; but scrapings from a whitewashed ceiling or wall can be used because so handy (*vide*, however, "Oxalic Acid Poisoning," p. 392).

Acids neutralise alkalies. Action, direct chemical.

Vinegar is at once most easily obtained and the safest acid to administer.

$NaCl$ decomposes $AgNO_3$. Action, direct chemical,

forming the insoluble (in the stomach) $AgCl$, but this should be got rid of as soon as possible, for it is distinctly a "noxious substance."

Albumen precipitates $HgCl_2$. Action, mixed physical and chemical,

and hence white of egg is the best antidote to corrosive sublimate poisoning, but the resultant precipitate must be got rid of like the $AgCl$ as soon as possible, and the same remark applies to the products formed when

dialysed iron	is used to	neutralise As,
tannic acid	,,	precipitate strychnine,
charcoal	,,	,, morphia and other alkaloids,
French oil of turpentine	,,	influence phosphorus.

This principle of an antidote or neutraliser is so important that several attempts have been made to concoct one of universal application. The following, copied from Murrell, is probably the best, but is very incomplete. It contains—

(1)	Saturated solution of $FeSo_4$	100	parts.
(2)	Calcined magnesia	88	„
	Charcoal	40	„
	Water	100	„

The two fluids to be mixed at the moment of using. Murrell states that it is ideal for arsenic, zinc salts, digitalis, and acids of the ordinary type, useful for mercury salts, morphine, and strychnine, but of no use for alkalies, phosphorus, tin salts, nor hydrocyanic acid.

3. **Keep the Patient alive by General Measures while his Eliminatory Organs are getting rid of the Poison.**—This means, combat the shock which is an almost invariable accompaniment of all poisoning cases (it is both bodily and mental); it also includes attempts to counteract by *general* means the particular physiological (pathological) effect of the poison. Diffusible stimulants, artificial respiration, warmth to the trunk and extremities, cold douches in HCN poisoning, keeping the patient awake in morphine poisoning, are the principal illustrations of these general methods that may be adopted. Attempts should also be made by simple demulcents and anodyne applications to relieve the pain in mouth or stomach.

4. **Apply Physiological Antidotes.**—This is known as the principle of antagonism; it is a deeply interesting but very obscure and ill-understood subject. Recent work by bacteriologists on Immunity and the formation of "antibodies" throws some interesting light on the theory of antagonism, and may some day place it on a sound scientific basis. It may be defined as the study of the power which different drugs possess of interfering with one another's action upon the ultimate cells of the body when brought into physical contact with those (in each case the same) cells. In our illustration above "antagonism" is the study of "*y*," the poison absorbed, so far as it can be neutralised or antagonised by a "*y*" of a remedy.

Two views are entertained as to the meaning of such interference or antagonism: (*a*) the chemical view that the drugs combine chemically with one another, and that only the resultant combination (which may be totally inactive) acts upon the cell; (*b*) the physiological view (which, after all, is probably dependent on intra- as opposed to extra-cellular chemistry) that the drugs influence the cells in different or contrary directions so as to alter or prevent the exhibition of that particular form of cellular energy which either individual drug would call forth.

It is possible on either view to conceive of a complete antagonism between two drugs, but in practice we find that it is usually limited to the cells of one or two systems. The following are a few examples with which all medical men may reasonably be expected to be familiar, as the drugs themselves are mostly in common use:—

ATROPINE *versus*	PHYSOSTIGMINE.
Quickens the heart by action on vagus.	Slows the heart by action on vagus.
Dilates the pupil.	Contracts the pupil.
Checks glandular secretion.	Promotes glandular secretion.
Regulates peristalsis.	Disturbs peristalsis.
Increases blood tension.	Diminishes blood tension.

This is the most complete case of antagonism known to us, but for individual systems we have—

Respiratory.	Chloral, Morphia, Aconite,	depress activity of the centre.	Strychnine	stimulates it.
Heart.	Aconite	depresses the strength of the heart.	Digitalis	increases it.
Blood-vessels.	Ergot, Suprarenal extract, Digitalis,	contract.	Nitrites of amyl, ,, ,, erythrol, ,, ,, sodium, etc.,	dilate them.

The above are illustrations of true antagonism, but a warning must be given as to false antagonism, *i.e.*, a mere antagonism of results, arising from the action of the alleged antagonists being exerted upon two different sets of cells. The best illustration of false antagonism is that between curare and strychnine. Curare, by its action upon motor-nerve terminals (? the actual muscle cells), prevents or abolishes the convulsions of strychnine poisoning which arise from the action of the drug upon the cells in the spinal cord or brain.

In practice the principle is made use of only to a limited extent. Thus atropine is given hypodermically to counteract the action of morphine; strychnine is habitually used in cases in which the respiratory or cardio-vascular centre seems to be failing. The great obstacle to a more extensive use in poisoning cases is that of dosage. We do not know the value of "*y*" above, and consequently are in the dark as to how much we dare, or ought to, give of the counteracting poison, for such our remedy really is at bottom. It is customary to give a full maximum therapeutical dose of the antagonist and watch its effects, administering another one in half an hour or so if necessary. The completeness or the reverse of the antagonism is another difficulty, for the remedy in uncounteracted directions may produce results which are worse than the disease. The subject cannot be profitably pursued any further in the present work. For fuller details the works of Sir Lauder Brunton or Professor Fraser may be consulted, also bacteriological works on Immunity.

C. Medico-legally.

This means the evidence that a medical jurist will have to bring before the Court to establish a charge of poisoning.

Now the three questions which constitute the fundamentals of the position are—

(1) What was the cause of death ?
(2) Why do you assert it was poison ?
(3) Why was it not disease ?

To answer these the medical jurist must therefore possess full notes in writing on—

(1) The symptoms.
(2) The post-mortem examination.

(3) The simple analysis.
(4) The complete chemical analysis (vomit, urine, stomach contents, organs, etc.) as to the presence of quantities (small or large) of definite poisons or poisonous "extractives."[1]

The Symptoms.

To go through every possible symptom that might arise from poison would be to introduce a work on medicine, but there are certain points which specially demand the attention of the medical jurist. The following are the most important:—

(1) Their nature—especially vomiting, purging, convulsions, coma, etc.—the absolute time of their occurrence, and the time relative to taking a meal or medicine, whether if present before they were more violent after a meal or medicine or any particular food.

(2) The order of their occurrence.

(3) Whether inter- or re-mittent, or continuous, becoming more aggravated up to death.

(4) Previous or contemporary known disease.

(5) The time at which he was summoned absolutely and relatively to the occurrence of symptoms. If delay, why?

(6) Voluntary explanation offered of the symptoms (maybe a dying declaration, *vide* Vol. I., p. 55). These must be noted as nearly as possible in the *ipsissima verba* of the patient. Note also any statements made by other persons present in the room who may be supposed to be concerned in the matter.

(7) Who shows them—*i.e.*, many who had taken a dish, or only one or two, etc.?

(8) Had the alleged cause been taken previously without ill effect?

(9) Note any circumstances bearing on the question of suicide, accident, or homicide, usually not very difficult to determine in cases of poisoning.

(10) Exact time of death absolute and relative to the swallowing the poison. If found dead, when was the patient last seen living or known to have been alive?

(11) If the patient has vomited, the vomited matters, especially those *first* ejected, should be procured, their odour, colour, and acid or alkaline reaction noted as well as the quantity. If none are procurable, and the vomiting has taken place on the dress, furniture, or floor of a room, then a portion of the clothing, sheet, or carpet, may be cut out and reserved for analysis. If the vomiting has occurred on a deal floor, a portion of the wood may be scraped or cut out, or if on a stone pavement, then a clean piece of sponge soaked in distilled water may be used to remove any traces of the substance. The vessel in which vomited matters have been contained will often furnish valuable evidence, since heavy mineral poisons fall to the bottom, or adhere to the sides. Observe whether vomiting has taken place in the recumbent position or not. If the person has vomited in the erect or sitting

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[1] This is a very convenient word adopted from M. Foster's "Text-book of Physiology" to indicate substances existing generally in small quantities and requiring special means for their extraction from a bulk of mixed (organic and inorganic) material. They include alkaloids, ptomaines, glucosides, etc., etc.

posture, the front of the dress will commonly be found covered with the vomited matters.

(12) Endeavour to ascertain the probable nature of the food or medicine last taken and the exact *time* at which taken. Also ascertain the nature of all the articles of food used just before the symptoms appeared.

(13) Any suspected articles of food, as well as the vomited matters, should be sealed up as soon as possible in a clean glass vessel, labelled, dated, and reserved for analysis. Observe all surrounding objects. Any bottles, paper packets, weapons, or liquids lying about should be collected and preserved. Any obviously recent stains on bedclothes, furniture, etc., should be saved if possible.

(14) *In preserving any matters at all, whether vomit, viscera, or casual articles, be especially careful to seal them up and keep them in such a manner and place that no one can tamper with them, and that you can recognise and identify them at any subsequent stage. Make a careful list of all of them.*

The patient may be dead on arrival or die very shortly, and we must now consider the points, additional to the above, necessary for the medical jurist to observe previous to and in making a post-mortem examination.

(1) The attitude of the body and dress and any stains or marks of destruction of the latter. There may here be evidence as to whether a struggle had preceded death, or violent convulsions, proofs of the nature of the poison—stains on dress—or of alleged vomiting, diarrhœa, etc. (For examination of such stains, *vide* Vol. I., pp. 128 *et seq.*)

(2) Note the external appearance of the body, whether the face is livid or pallid, whether the countenance is composed or distorted. These may be of importance in regard to the nature of the poison and its action. Poisoning by HCN, strychnine, aniline dyes, etc., etc., may give this preliminary hint. The points may be corroborative of, or contradictory to, some other evidence. Note also any signs of corrosion of lips and round the mouth suggesting corrosive poisoning.

(3) Look carefully for all marks of violence, bruises, cuts, wounds of any nature; they might suggest either a struggle or some form of death other than poison.

(4) Note the degree of warmth of the body (for choice taken in the rectum or vagina), also the presence or absence of rigor mortis. These points are of great value in determining the time of death (*vide* Vol. I.). In noting the temperature, the circumstances (Vol. I., pp. 327 *et seq.*) in reference to rapidity of cooling must be observed, and similarly those (Vol. I., pp. 270 *et seq.*) regarding the onset of rigidity, which is frequently influenced by poison in an especial degree.

(5) Note the time, both absolute and relative to the time of death, at which the autopsy is made—this has reference to signs of putrefaction—and any other points enabling the examiner to fix the (if unknown) time of death. In relation to these *external* appearances, there are none which are specially indicative of poisoning upon which we can safely rely. It was formerly supposed that the bodies of persons who were poisoned putrefied more rapidly than those of others who had died from natural disease; and evidence for or against

poisoning was at one time derived from the external appearance of the body. This is now known to be an error. The bodies of persons poisoned are not more rapidly decomposed, *cæteris paribus*, than those of others who have died a sudden and violent death from any cause whatever. Indeed, with some (antiseptic) poisons it is rather the reverse, for the poison inhibits the action of putrefactive bacteria (*vide* Vol. I.).

THE INTERNAL APPEARANCES AND SIMPLE ANALYSIS.

There is no special order peculiar to poisoning cases in which the post-mortem should be done. The only thing is that *all* organs *must* be examined, and for convenience we may take the alimentary system first, for it is here, if anywhere, that special signs of poisoning are likely to occur.

1. On opening the body be careful to note any **peculiar smell** that may be observable. Chloroform, ether, hydrocyanic acid, HCN, and a few other poisons may possibly give this early suggestion.

2. Note the **tongue, mouth, and gullet** for any evidence of inflammation or erosion or staining. (For colour of this and the hints it gives, *vide* "Stomach.") Also look for scars and stricture. A person has been known to die from a stricture of the gullet brought on by sulphuric acid *eleven months* after the poison was swallowed; and there is no reason to doubt that instances may occur of a still more protracted nature.

3. Note the **stomach.**

(*a*) Its Walls.

(1) **Colour.**—They may be normal in colour and appearance; in fact, it is only corrosives and irritants that are likely to markedly alter the colour. Nothing but an extensive experience in the post-mortem room can enable a medical jurist to state what is the natural colour, but it is commonly pale, with only a few small vessels definitely visible on the mucous membrane, generally arranged stellately. If an irritant has been at work, it is likely to be red, either in large patches not absolutely uniform all over, or in smaller patches which can be shown to be—or rather the patches which have escaped can be shown to be—due to foldings of the mucous membrane from intense spasm of the muscular layer. Genuine inflammation from an irritant is likely to show small hæmorrhagic foci, though these may be produced by violent vomiting due to other causes than administered poison. Be cautious, in fact, from mere redness (*vide* Vol. I., p. 345) in assigning irritant poisoning as the cause. Other colours than red may be present and due to definite causes. For instance, mercury commonly causes a slate-coloured stain; arsenic may show white particles adherent, or possibly a yellow sulphide which has been found long (months at least) after death; strong sulphuric acid and possibly concentrated oxalic acid are likely to have blackened or charred the wall; nitric acid will have probably turned it yellow (xanthoproteic action); carbolic or

hydrochloric may have turned it white and shrivelled, though they commonly enough also blacken it, as the editor can affirm from personal observation. The congestion outside the stomach may be differentiated from hypostasis by stretching (*vide* Vol. I.). The colour may possibly be due to bile (yellowish red), when there will be no signs of inflammation, and the colour will be outside; or to fruit juice, it is then uniform and also without signs of inflammation.

There is an important class of cases in which redness of the mucous membrane of the stomach is found after death not dependent on the action of poison or on any easily assignable cause. These cases, owing to their being so little known, and involved in much obscurity, deserve the attention of medical jurists, since the appearances closely resemble those produced by irritant poison. A person may die without suffering from any symptoms of disordered stomach; but on an inspection of the body a general redness of the mucous membrane of this organ will be found, not distinguishable from the redness which is so commonly seen in arsenical poisoning. Several cases of this kind have occurred; and drawings which have been made of the appearances presented by the stomach are preserved in the museum collection at Guy's Hospital. In January, 1904, the editor met with a similar case in the post-mortem room at the London Hospital. He was quite at a loss to account for it, as there was nothing in the symptoms preceding death, nor in the cause of death (heart disease), to which it could be attributed. This condition is not infrequent after death from heart disease. Tidy was of opinion that there is always ecchymosis of the stomach after death from arsenical poisoning; but Dr. Stevenson met with several cases in which this condition had not existed. A case occurred in Guy's Hospital some years ago in which, with a small circular patch of ulceration near the cardiac opening, the whole mucous membrane was red and injected; but this singular condition of the stomach, so closely resembling the effects of an irritant poison, was unaccompanied by any marked symptoms of irritation during life.

The redness of the lining membrane of the stomach, in cases of poisoning, is so speedily altered by putrefaction, when circumstances are favourable to this process, as frequently to render it impossible for a witness to speak with any certainty upon its cause. Putrefactive infiltration from the blood contained in the adjacent viscera and muscles will give a reddish appearance to a stomach otherwise in a healthy condition. Great dispute has arisen respecting the length of time during which redness of the stomach produced by an irritant will be recognisable and easily distinguishable from putrefactive changes. It is sufficient to say that no certain rule can be laid down on the subject; it must be left to the knowledge and discretion of the witness. The author has seen the well-marked appearances of inflammation produced by arsenic in the stomach and duodenum in an exhumed body twenty-eight days after interment (*R.* v. *Jennings*, Berks Lent Ass., 1845); and in other instances the reddened state of the mucous membrane, in a case of arsenical poisoning, was plainly perceptible on removing a layer of arsenic *nineteen months* and twelve months respectively after interment. (See on this question a case of suspected poisoning by Orfila, "Ann. d'Hyg.," 1839, 1, 127.) If, however, there should be a reasonable doubt respecting the cause of redness, and no poison is detected, it would be unsafe to rely upon this appearance as evidence of poisoning.

(2) **Ulcers.**—If the corrosive have been sufficiently strong to produce ulceration there will also be signs of very intense inflammation, which should prevent such ulcers being mistaken for cancerous, chronic simple, or acute simple ulcers, none of which in other respects look like those of corrosives, when the case is one of recent poisoning at any rate. When the poisoning is of older date it is impossible to differentiate the ulcer from a simple chronic ulcer by its appearance only, though the history and other circumstances in the ulceration may do so. Thus—

In March, 1904, the editor opened the stomach of a young adult who in the previous September had swallowed a corrosive by accident. His main symptoms had been gastric pain and vomiting ever since, and he died of exhaustion. The stomach was very thin and distended, chiefly upwards under the ribs. Over an area at the pyloric end of the stomach, roughly the size of the hand with the fingers together, was a stellate scar, with bands of thickening, very like the scar of an extensive burn on the skin. A second unhealed ulcer occupied the exact pyloric orifice and about an inch each of gastric and duodenal mucous membrane. There was in addition a scar with longitudinal lines and patches of thickening in the last three inches of the œsophagus.

It was possible from the superficial character and large extent of the scar in the stomach to assert that it had come from a large superficial wound of the organ, and to say that such was probably from a poison, because, had such an extensive ulcer been due to disease, it would, according to all experience, have caused adhesion between the stomach and the neighbouring viscera, and of such adhesion there was no trace. The ulcer, still unhealed, actually in the grip of the pylorus, could not be distinguished by its appearance from one due to disease, but its very position, extremely unusual in disease and equally common as the result of corrosives, was strongly suggestive. In the œsophagus simple ulceration, with a consequent scar, is practically unknown. Cancerous, diphtheritic, and tubercular are the only ones except those due to corrosion.

In irritant poisoning the stomach is occasionally found ulcerated; but this is, comparatively speaking, a rare occurrence. In such cases the mucous membrane is removed in small distinct circular patches, under the edges of which the poison (arsenic) may be found. Ulceration of the stomach is a more common result of disease than of the action of poison. It is worthy of remark, as a means of distinction, that ulceration has never been known to take place from arsenic or any irritant poison until symptoms indicative of irritant poisoning have occurred, while the ulcers of disease are frequently latent until perforation or hæmorrhage leads to a fatal result. In ulceration from disease, the mucous membrane is commonly only reddened in the neighbourhood of the ulcer. In ulceration from poison, the redness is generally diffused over other parts of the stomach, as well as over the duodenum and small intestines. The history of a case previous to death will commonly enable us to determine to what cause the ulceration found may be due. As a final distinction between poison and disease, it is well to note that in the former there will be a dead slough over the ulcer, while in disease such a slough (or scab, as it were, in popular language) is never seen except with cancer. With regard to this latter affection, cancer, a problem might arise in an old poisoning case as follows. Cases are reported (the editor has seen at least two cases) in which a chronic ulcer of the stomach has existed with cancer in such connection as to suggest in the strongest possible manner that the cancer was the actual immediate result of the (irritation of) simple ulcer: if the original simple ulcer were due to poison a grave responsibility might be thrown on the medical jurist of deciding whether death was due to the poison or whether the cancer would have arisen in any case: another (sarcomatous) form of malignant tumour (in the limbs) is frequently reported to arise from a blow.

(3) Other Conditions of the Walls.

Actual perforation is occasionally witnessed when the strong mineral acids have been taken, especially sulphuric acid; it is much less common with the other acids. The stomach, in such cases, is blackened and extensively destroyed, the aperture is large, the edges are rough and irregular, and the coats are easily lacerated. The acid escapes into the abdomen, and may be readily detected there by chemical analysis, though the concomitant acute peritonitis renders analysis unnecessary. The perforation caused by irritant poison (arsenic) is but little known. There are but few instances on record. In a great number of poisoned subjects examined during many years at Guy's Hospital not a single case occurred. It must then be looked upon as a rare appearance in cases of irritant poisoning.

Perforation from poison must be carefully distinguished from perforation from disease and also from digestive perforation. There should be no difficulty in the former case, for the ulcer of disease, when free from adhesions and thickening, never shows the signs of intense irritation which must be met with when poison has gone so far as to perforate, and in the majority of cases there are either old adhesions to other organs or (and) great thickening of the coats of the stomach from scarring. The aperture of perforation is totally different in the two cases: in poison it is ragged and irregular with torn edges; in disease it is more or less rounded, punched out as it were. As, however, perforation from an ulcer is perhaps the disease above all others which most closely resembles irritant poisoning, it may be well to insert the following features in the history.

The principal facts observed with regard to idiopathic perforating ulcer are the following:—1. It often attacks young women from eighteen to twenty-three years of age. 2. The preceding illness may be extremely slight; sometimes there is merely loss of appetite, or a capricious appetite with uneasiness after eating. 3. The attack commences with a sudden and most severe pain in the abdomen, generally soon after a meal. 4. Vomiting, if it exists at all, is commonly slight, and is chiefly confined to what is swallowed. There is no purging; the bowels are generally constipated. 5. The person dies commonly in from eighteen to thirty-six hours; or rapidly develops an acute purulent peritonitis, causing death in a few days if not surgically treated.

With these points may be contrasted the behaviour of the stomach in irritant poisoning thus: 1. Neither sex nor age has anything to do with the case. 2. Nor has preceding illness nor health. 3. The pain is not so sudden in rising to great intensity, but usually comes on gradually, and slowly rises to considerable severity. 4. Vomiting or retching is incessant and independent of food or anything admitted to the stomach ; purging is very common indeed. 5. Eighteen to thirty-six hours is also the average period of death in the most common form of irritant poisoning, *i.e.*, by arsenic ; but in no case yet recorded has arsenic caused perforation of the stomach within twenty-four hours ; and it appears probable that a considerable time must elapse before such an effect could be produced by this or any irritant. Notwithstanding the well-marked differences above described, it is common to meet with cases of imputed poisoning where death has really occurred from peritonitis following perforation from disease ; one of them will be found elsewhere recorded (Guy's Hosp. Rep., 1850, p. 226). In another, the body was exhumed after several months' burial, and the stomach was found perforated from disease in the usual situation.

Softening.—The coats of the stomach are not unfrequently found so soft as to yield and break down under very slight pressure ; and this may be the result either of poisoning, or of the solvent action of the gastric juice after death. As this condition of the stomach, when caused by poison, is produced by those substances only which possess corrosive properties, it follows that in such cases, traces of their action will be perceived in the mouth, throat, and gullet. In softening from post-mortem digestion, the change will be confined to the stomach alone, and it is commonly found only at the cardiac or greater end of the organ. The editor has only once seen post-mortem digestion of the œsophagus with much softening and perforation. When softening is really caused by an irritant poison, it is generally attended by other striking and unambiguous marks of its operation. Softening is not to be regarded as a common character of poisoning: it is only an occasional appearance. Softening can never be inferred to have proceeded from poison, unless other well-marked changes are present, or unless the poison is discovered in the softened parts. The stomachs of infants have been frequently found softened from post-mortem digestion ; such cases could not be mistaken for poisoning, since the history of them during life, the want of other appearances indicative of poisoning, and the total absence of poison from the viscera, would prevent such a suspicion from being entertained.

It is in poisoning by the alkalies that such softening is most commonly found (so far, that is, as poisons are concerned) ; they have a great tendency to cause any tissues with which they come in contact to assume a soft soapy feel and consistency, though they perhaps as often (especially if concentrated) harden and shrivel the stomach.

The spontaneous or digestive perforation is not a very common phenomenon, but post-mortem thinning or digestion of the inner coats is an almost constant phenomenon, and the question of actual perforation is merely one of degree ; but *vide* Vol. I. for further remarks on the subject. An inspection of the body, with a general history of the case, will commonly suffice to remove any doubt in forming an opinion whether the extensive destruction so commonly met with has or has not arisen from poison. Thus, in a cadaveric perforation, the aperture is generally situated in that part of the stomach which lies to the left of the cardia; it is very large, of an irregular form, and ragged and pulpy and softened at the edges, which have the appearance of undergoing the process of digestion, as, in fact, they are. The mucous membrane of the stomach is not found inflamed. There is occasionally slight redness, with dark brown or almost black lines (striæ) in and near the dissolving coats, which have an acid reaction. The cardinal point of distinction from the softening of poison is the complete absence of peritonitis in the cadaveric perforation.

Hardening.—This is not a frequent result of poisoning, but is occasionally found. The author has met with an instance in which the coats of the stomach were considerably hardened by sulphuric acid; and Dr. Stevenson has found that carbolic acid usually hardens the tissues with which it comes in contact.

(4) **The Contents of the Stomach.**—The walls must be carefully examined for fragments of poison adherent to it. Bismuth, calomel, arsenic, chalk, fragments of leaves or fruit, cantharides, etc., etc., may all of them be possibly found in this situation.

Then the free contents must be also carefully observed and written notes made with reference to

(*a*) Quantity.
(*b*) General nature, food, etc.
(*c*) Colour, etc.

Of great importance for corroborating or contradicting evidence from other sources as to time and nature of last meal, presence of vomiting, etc., etc.

(*d*) The presence of matters not commonly considered as foods; cantharides wings, berries or leaves or other parts of plants, bile, blood, and articles such as nails, pins, glass, etc., distinctly foreign.

(*e*) *Odour.*—By simple smell many substances may be detected. Opium, chloroform, carbolic acid, phosphorus, hydrocyanic acid or cyanides, benzene, camphor, are illustrations. If the contents have no smell in the cold, a small quantity may be warmed gently in a clean beaker, and the nose again applied. Nicotine, cocaine, phosphorus (garlic smell), even carbolic acid, may thus become more apparent. It is well to get two or three independent persons to note the odour both in the cold and when the contents are warmed.

(*f*) Reaction to litmus paper—alkaline—suggests poisoning by corrosive alkalies; neutral gives little positive information, but suggests such vomiting as to have exhausted the acid-secreting cells; acid is the natural reaction. The violence of it may suggest a strong acid poison, but if some poison is certainly present, and there are no gross naked eye changes, an acid reaction makes it probable that the poison will require the prolonged search of the next section.

(*g*) Note any other special characters not included in the above.

4. Note the duodenum and its contents with the same care, and for similar purposes, as the stomach: poisons rarely cause duodenal ulcers, but inflammation is frequently met with here, as in arsenical poisoning, for example. Inasmuch as the duodenum lies so near to the gall bladder, we must repeat the caution not to mistake a yellow or green discoloration produced by bile as a sign of inflammation or of poison.

5. Proceed then to note the condition of the rest of the small intestine. It is very rare indeed for inflammation from irritants—*i.e.*, poisons—to reach far down from the stomach; very extensive inflammation is far more likely to occur from disease or from decomposed

food. It may be said that ulceration of the small intestine is always due to disease, tubercle, typhoid, or possibly so-called stercoral ulcers.

6. The state of the large intestine and of its contents, even more carefully than that of the small, must next be observed. Arsenic seems to have a special effect upon the rectum when no traces of it can be found between duodenum and colon. The discovery of hardened fæces in the colon and rectum may go a long way towards proving or disproving a history of purging before death. Some care must be exercised in ascertaining that the purging was genuine, and not a mere false diarrhœa (mucus and blood with tenesmus), for in 1896 the editor found a colon and rectum full of hard scybala in a patient who was stated to have had a lot of diarrhœa previous to his death, which had nothing to do with poisoning. The point might be of very great importance in chronic or secret poisoning.

7. All the other viscera—lungs, heart, brain, spinal cord, uterus, ovaries, kidneys, liver, etc.—must be equally carefully examined for signs of disease of which the patient might have died, for negative evidence of this description is one of the first things to rouse a suspicion of poisoning in some cases that have not been carefully observed during life.

8. The bladder and (in females) the vagina should be particularly examined, for poison has been known to be introduced into the body by these channels.

The only details in the above manipulations that require special mention are—

(1) Ligature the stomach at each end before opening or removing it.

(2) Ligature the duodenum at each end before opening or removing it.

(3) If either of these viscera is to be opened at once, place it unopened in a clean dish, so that it and its contents are not contaminated with unknown materials.

(4) Similarly on opening the bladder aspirate its contents into a clean bottle.

(5) Take care that every viscus or material that requires to be saved is placed in a *clean* vessel securely sealed and also numbered or marked in such a way as to be identifiable. Do not wrap them up in the first piece of paper that comes to hand nor place them in any old and dirty bottle. A case has broken down because a piece of wall-paper containing arsenic was once thus used.

It is necessary to bear in mind on these occasions that the body is inspected, not merely to show that the person has died from poison, but to prove that he has *not* died from any *natural cause*. Medical practitioners commonly give their attention exclusively to the first point; while lawyers, who defend accused parties, very properly direct a most searching examination to the last-mentioned point, *i.e.*, the healthy or unhealthy state of those organs which are essential to life, and with which the poison has not probably come in contact. The usual causes of *sudden death* have their seats commonly in the brain, the heart and its great vessels, or in the lungs. Marks of effusion of blood, congestion, inflammation, suppuration, or a diseased condition of the valves of the heart, should be sought for and accurately noted, whatever may be the condition of the abdominal viscera. It has also been recommended that an examination of the spinal marrow should be made. If the cause of death be obscure after the general examination of the body, there is good reason for inspecting the condition of this organ.

In cases of *chronic poisoning* there is sometimes great difficulty in assigning death exclusively to the original action of the poison, since the habits of life of the person, a tendency to disease, and other circumstances, may have occurred either to accelerate or produce a fatal result. To connect a stricture of the gullet (proving fatal) with the effects of poisoning by a mineral acid it would be necessary to show that there were no indications of this disease before the acid was administered; that the symptoms appeared soon after the first effects of the poison went off; that these symptoms continued to become aggravated until the time of death; and, lastly, that there was no other cause to which death could with any probability be referred. These remarks apply equally to the secondary fatal effects of any poisons, such, for instance, as the salivation occasionally induced by corrosive sublimate, and the exhaustion and depression which are caused by tartarated antimony, when the acute symptoms of poisoning by these substances have passed away.

It is important, as a last general remark on the autopsy, to bear in mind that, except for corrosives and irritants, it is extremely easy and common for poison to destroy life without leaving any naked-eye changes, and proofs of poison must be derived either from quite other sources or from the detailed chemical examination.

THE COMPLETE ANALYSIS AND THE DUTIES OF THE EXPERT ANALYST.

Before undertaking to appear in court the expert analyst must be prepared to answer the following questions, because in court all the points must be proved to the hilt. The strength of a chain is that of its weakest link, and many charges of poisoning have broken down through oversight of some apparently irrelevant detail.

1. **When, Where, and from Whom did you receive the Articles which you have Analysed?**—These are but elementary and obvious questions in regard to the identity of substances received; they only emphasise the importance of immediately making written notes upon such serious matters.

2. **In what State was it Received?**—*Were they secured in any way?—if so, how?—or exposed, wrapped in paper, rag, etc., in an open box or tin, etc., etc.? Did you receive more than one object? If so, how many? Was each separately labelled, or in a separate receptacle? What quantity was there of each by weight or measure? Solid? Liquid?*—These are searching questions on the identity of what was preserved by the maker of the autopsy with what was received by the analyst. A few remarks have already been made in notes on the autopsy, but the matter is so important that Dr. Taylor's original remarks must be inserted in full. He said:—

It is necessary to observe that all legal authorities rigorously insist upon proof being adduced of the *identity* of the vomited matters or other liquids taken from the body of a deceased person when poisoning is suspected. Supposing that during the examination the stomach and viscera are removed from the body, they should never be placed on any surface, or in any vessel, until we have first ascertained that the surface or vessel is perfectly *clean*. If this point be not attended to it will be in the power of counsel for the defence to raise a doubt in the minds of the jury whether the poisonous substance might not have been accidentally present in the vessel used. This may be regarded as a very remote presumption; but, nevertheless, it is upon technical objections of this kind that acquittals follow in spite of the strongest presumptions of guilt. This is a question for which every medical witness should be prepared, whether he is giving his evidence at a coroner's inquest, or in a court of law. Many might feel disposed to regard matters of this kind as involving unnecessary nicety and care, but if they are neglected it is possible that a case may be at once stopped, so that the care subsequently bestowed upon a chemical analysis will be labour thrown away.

Evidence of the presence of poison in the contents of a stomach was once rejected at a trial for murder because they had been hastily thrown into a jar borrowed from a neighbouring grocer's shop; and it could not be satisfactorily proved that the jar was clean and entirely free from traces of poison (in which the grocer dealt) when used for this purpose.

When the life of a human being is at stake, as in a charge of murder by poisoning, the slightest doubt is always interpreted in favour of the accused.

Not only must clean vessels be used for receiving any liquid destined for subsequent chemical analysis, but care must be taken that the *identity* of a substance is preserved, or the most correct analysis afterwards made will be inadmissible as evidence. The suspected substance, when once placed in the hands of a medical man, should never be let out of his custody. It should be kept sealed under his private seal, and locked up while in his possession, in a closet to which no other person can have access. If he has once let the article out of his hands, and allowed it to pass through the hands of several other persons, he complicates the evidence for the prosecution by rendering it indispensable for these persons to state under what circumstances it was placed while in their possession. The exposure of a suspected substance on a table, or in a closet or room to which many have access, may be fatal to its identity; for the chemical evidence so important in a criminal investigation will probably be altogether rejected by the court.

A case was tried in which an analysis of certain matters vomited by a person poisoned with arsenic was not admitted as evidence against the prisoner because the medical man had left them in the custody of two women; and these women had allowed the vessel containing the suspected liquid (which was proved to contain arsenic) to be exposed in a room open to the access of many persons. In another case, the analysis of some suspected liquids was not allowed in evidence because the practitioner, who lived in the country, and was unwilling to take the responsibility of analysing them, had sent them up to town by a carrier, to be examined by a chemist.

If sealed by a private seal, and this is observed by the receiver to be unbroken before he proceeds to an analysis, this mode of transmission may not perhaps be objected to. When any article is reserved for analysis, care should be taken to at once attach to it immovably, or to the vessel containing it, a label, upon which are plainly written in ink the name of the deceased and the date, including the day of the week and month. This is especially necessary when there are two or more articles for analysis. The greatest inconvenience has resulted from the neglect of this simple precaution.

Preserving Articles for Analysis.—In removing viscera or liquids from the body, and reserving them for analysis, it is necessary to observe certain precautions. A clean vessel with a wide mouth should be selected; it should be only sufficiently large to hold the organ or liquid (the less air remaining in it the better); it should be secured by a closely fitting clean cork, covered with bladder or gutta-percha tissue. A piece of skin, sheet-caoutchouc, or gutta-percha should then be tied over the mouth. It should lastly be covered with a layer of white leather. In this way any loss by evaporation is prevented, and the viscera may be preserved in a cool place for some time; decomposition to some extent cannot be prevented, for antiseptic chemical compounds must not be added lest they should confuse the analysis. It is true that decomposition may produce bodies not in the original stomach, but it is within a skilled analyst's power to make allowance for these without confusion. If the mouth of the vessel be too wide for a cork, the other articles cannot be dispensed with. Paper only should not be used: the appearances after death of the viscera of an infant, suspected to have died from poison, have been entirely destroyed by drying from the evaporation which took place through the layers of paper with which the vessel in which they were contained was covered. The practitioner should bear in mind that all these matters are likely to come out in evidence; and whatever is worth doing at all is worth doing well.

The articles used for the preservation of viscera should in all cases be scrupulously examined. Some kinds of calico are dressed with arsenic and starch paste, and many kinds of wrapping paper as well as wall-papers are strongly impregnated with this poison. An observation made by Aickin shows that this is not an unnecessary caution.

> He was engaged in examining the body of a child, in order to determine the cause of death. The organs were healthy, and as no sufficient cause presented itself, he removed the stomach with a view of making an analysis of its contents. He was suddenly called away; and, to preserve the stomach, he wrapped it in a piece of paper (used for papering rooms), placed it on the uncoloured side, and locked it in a closet until the following day. Assisted by a friend, he then analysed the contents, and found a trace of morphine with a large quantity of arsenic. As the symptoms from which the child had suffered were not those of poisoning with arsenic, and there were no appearances of the action of this substance on the body, he came to the conclusion that there must be some extraneous cause to account for its presence. He examined a portion of the wall-paper in which the stomach had been wrapped, and then found that that part of it which was coloured yellow was tinted with arsenious sulphide or orpiment. It was therefore evident, as commercial orpiment contains white arsenic, that the stomach and its contents had imbibed a portion of the poison during the night (*Lancet*, 1855, 1, p. 633).

This satisfactorily accounted for the presence of arsenic under circumstances which might have given rise to a false charge of murder. Many wall-papers, having a tinge of green or golden yellow in them, contain arsenic, and this arsenic spreads by imbibition to other parts of the paper not so tinted. It would, of course, be proper to avoid in all cases the use of any wrapper having upon it mineral colours of any description. The above case shows in a striking manner the danger of trusting to chemical analysis alone. Unless we look to physiology and pathology, a most erroneous opinion may be expressed.

Arsenic is sometimes found mixed with ferric oxide in ochreous deposits or soils. It is thus occasionally present in the soil of cemeteries, but in an insoluble form. Even in the fur deposited in tea-kettles, in which there is generally some ferric oxide, arsenic has been found in an insoluble form. From about a pound and a half of the crust or fur of a vessel used for boiling water Otto obtained well-marked arsenical deposits. Pöllnitz detected in the fur of kettles, copper, lead, tin, and even antimony. Osborn confirmed Pöllnitz's conclusion, namely, that lead may be present in an insoluble form in the deposits of kettles and boilers (*Med. Times and Gaz.*, 1860, 2, p. 608). Otto discovered a much larger proportion of arsenic in the calcareous crust taken from a kitchen boiler. Ten ounces of this gave a deposit of arsenic in a glass tube, and several stains on porcelain. He thinks that, if a sufficient quantity is employed, arsenic will be found in the sediments of all spring and well-waters ("Ausmit. d. Gifte," 1856, p. 61). The author has found arsenic in the water of rivers used for the supply of towns, and has extracted a well-marked quantity from two ounces of the dried mud of the Thames, as well as from similar quantities of earth taken from three churchyards in the north of England (Guy's Hosp. Rep., 1860: "On Arsenic and Antimony"). Sir Thos. Stevenson has found it in river water receiving the effluent from tanneries, in which arsenic is largely used. These facts tend to show the extreme danger of placing reliance on minute chemical results in the absence of good physiological and pathological evidence.

The results of an analysis, in the shape of sublimates or precipitates, should be preserved as evidence, distinctly labelled in small glass tubes, hermetically sealed. They can then, if asked for, be produced for examination at the inquest or trial.

The importance of this is emphasised by the following notes in the *Lancet*, 1896, 1, p. 586, *in re* the Huddersfield poisoning case by white precipitate.

> Justice Grantham deprecated the practice of passing articles for chemical examination through so many hands. Justice Hawkins made a similar complaint in the Lamsom case. In the Flannigan and Higgins case a most important piece of evidence was nearly excluded because a police official was lax in preserving the identity of an important article. The moral is, let the medical witness himself secure and lock up everything which ought to be sent to the analyst. This will save time, trouble, expense, and prevent a possible miscarriage of justice.

3. **When did you Analyse it, and Where?**—These questions obviously tend to criticise the circumstances under which the analyst kept any material entrusted to his care. They raise the possibility that delay might have afforded opportunity for fraud, mischief, or decomposition.

4. **Did you Analyse it alone, or were you assisted?**—*If so, by whom and to what extent?*—These questions obviously are directed at the competency of the analyst and his assistants. They

also may raise a suspicion of the *boná fides* of the assistants and the opportunities any of them may have had for interference by carelessness or accident.

5. **What Tests did you employ?**—In a written report these need not be minutely described: a general outline of the analysis will suffice; but in court defending counsel may cross-examine an analyst very closely on the tests he employed. As corroborative tests applied to comparatively pure substances, every analyst will have several to which he may attach special importance or with which he may be peculiarly familiar, but there are one or two general or preliminary procedures which are practically universally adopted when gross masses of animal remains [viscera and (or) their contents] are presented to an analyst that he may determine the presence in them of poison. The first of these is known as the Otto-Stas process for the extraction of alkaloids as modified by Stevenson and given by Sir Thos. Stevenson himself in Watt's "Dict. of Chem.," 1888, vol. 1, pp. 120 *et seq.* It runs as follows:—

> The method most generally employed for the extraction of the vegetable alkaloids from admixture with animal matters is that originally devised by Stas for the separation of nicotine, and now known with modifications as the Otto-Stas method. Dr. Stevenson has introduced further modifications, which are embodied in the following description, having been found by him necessary in those cases where unstable and easily hydrolysed alkaloids are to be sought for, such as morphine, which is readily decomposed by heating its acidified solutions, and aconitine, which is unstable in alkaline, and especially in ammoniacal solutions. In all cases the method, which is a quantitative one, is greatly dependent for success upon the care with which the preliminary operations are conducted.
>
> The organic material to be operated upon, if solid, is brought into as minute a state of division as its nature permits, and is then digested with twice its weight of rectified spirits of wine at a temperature of about 35° C. Liquids are also treated with twice their volume of rectified spirit. Redistilled methylated spirit may be used for these operations.
>
> After several hours' digestion the liquid is poured off from the deposited solids, and the digestion repeated with a fresh quantity of spirit. This is again poured off and mixed with the previous alcoholic infusion. If solid matter, *e.g.*, liver, is operated on, the liquid is squeezed from the solid portion at each digestion in a piece of fine cambric, which acts as a crude filter; the liquids thus obtained are added to the other alcoholic liquids. After two or more digestions, according to the nature of the organic matter, the undissolved portions are submitted to a new digestion, also at 35° C., with spirit faintly acidified with acetic acid. Some recommend tartaric in preference to acetic acid, but this is objectionable when, as is usually the case, morphine has to be sought for. Others use oxalic acid, but this acid may have to be sought for as well as the alkaloids. Enough acid must be added to keep the liquid just perceptibly acid, excess being avoided.
>
> After a prolonged digestion with the acidified alcohol this is poured off, the solids squeezed, and the digestion repeated, but this time with unacidified spirit. A final digestion may be required, the rule being to continue the exhaustion with spirit so long as any colour is imparted to it.
>
> The alcoholic liquids obtained before acidification after mixing are momentarily and rapidly raised to a temperature of 70° C., cooled, and the insoluble residue filtered and washed with spirit; those obtained with and after the use of acid are similarly treated; but the two sets of liquids, the unacidified and the acidified, are not mixed till a later stage is reached. By keeping them thus separate, danger of hydrolisation of unstable alkaloids is as far as possible avoided.
>
> The alcoholic infusions are now evaporated at a temperature never exceeding 35° C. to the consistency of a syrup. It is advisable during these evaporations (each set being done separately) to neutralise a portion of the free acid with caustic soda from time to time, so as to keep the liquids just perceptibly acid. The evaporations are easily effected with tolerable rapidity by placing the liquids in

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shallow basins supported on large beakers some inches above the floor of an ordinary oven, which is heated by a gas flame playing on the top. The door is kept a little ajar. The advantages of this arrangement are that overheating is avoided, evaporation is more rapid than by any other method, and all creeping of the liquids up the sides of the basins is avoided.

The syrupy liquid is now drenched with about 30 c.c. of absolute alcohol, with constant stirring or grinding in a mortar; the alcohol is poured off from the pasty mass, which usually separates, and replaced by successive quantities of 15 c.c. of alcohol so long as a colour is imparted to it.

The alcoholic liquids are mixed, filtered, the filter washed with alcohol, and the filtrate evaporated in the oven as before at a temperature not exceeding 35° C.

The syrupy residues—that from the plain and that from the acidified spirit—are diluted with a small quantity of water, filtered, the filters washed with water, and the filtrates mixed. The liquid thus obtained, about 15—20 c.c., is introduced into an accurately stoppered tube, partially neutralised if necessary with caustic soda, taking care, however, to leave it slightly acid. If the method laid down has been scrupulously followed, we have now a liquid containing the whole of the alkaloids and free from albuminoids.

The aqueous faintly acid liquid in the tube is now covered with twice its volume of washed ether, and the whole is mixed by gently and repeatedly inverting the tube, care being taken not to emulsify the mixture by any violent agitation.

The ether is allowed to separate. This may be favoured by a sharp rotatory movement of the tube. The supernatant ether is pipetted off and replaced by a new and smaller quantity of ether. The extraction is continued in this way till a few drops of the ether leave no residue on evaporation; four or five such extractions will generally suffice.

The ethereal solutions as they are pipetted off are successively washed by a vigorous shaking in a second stoppered tube with 5 c.c. of water, to which a few drops of dilute sulphuric acid have been added.

The ether on evaporation may yield an oily residue, which may be reserved for further examination and for physiological tests. The acid liquid subjected to ethereal extraction will still contain nearly all the alkaloids, as the acid salts of these are mostly practically insoluble in ether; some of the salts of the alkaloids, being perceptibly soluble in ether, may be met with in the acid ether extract.

The acid aqueous solution and the acidulated water with which the ether has been washed are mixed, alkalised with sodium carbonate, and again exhausted four or five times as before with washed ether, only in this case the first exhaustion is made with a mixture of one volume of chloroform with three volumes of ether, the final extractions with ether alone. These successive ethereal extracts are washed in a tube by shaking anew with 5 c.c. of water; they are then transferred to a third and finally a fourth tube (the first containing 10 c.c. water acidulated with a few drops of sulphuric acid, and the last containing 5 c.c. water alone) and agitated.

By these operations the alkaloids are first liberated from their salts by the alkali, then transferred to the ether chloroform, in which they are soluble, then again converted into sulphates, which, being insoluble in ether and chloroform, again pass into the acid solution, impurities being left behind in the ether.

We have now the alkaloids in acid solution in a much purer state than before.

The acid liquid and the final washings are mixed, washed with a little ether once or twice, then realkalised with sodium carbonate and well re-extracted with chloroform ether and ether.

These ethereal solutions are washed with water barely alkalised with sodium carbonate, then filtered through a dry filter, and evaporated to dryness in an oven at a temperature not exceeding 35° C. in tared glass basins, about 8 c.m. in diameter.

Once dry, the residue may be transferred for a few minutes to the water oven and dried at 100° C. and weighed after cooling over sulphuric acid. This weight fairly represents that of the alkaloids. It is well before evaporating the bulk of the liquid to evaporate a few cubic centimetres only. If an oily odorous residue be left, the presence of a volatile alkaloid is indicated; the evaporation is then modified by mixing the ether chloroform with so much ether, previously acidulated by agitation with a strong solution of hydrochloric acid, as is necessary to render it acid. In this case it is not the free alkaloids, but their non-volatile hydrochlorides, which are left and weighed. The residue may, therefore, be dissolved in water and subjected to appropriate tests.

Morphine requires special modifications (*vide* "Poisoning by Morphia").

For other remarks on alkaloids, also on Dragendorff's, Selmi's, Sonnenschein's, Uslar and Edman's, and Scheibler's methods of their separation, the reader is referred to the same article which was written by Dr. Stevenson for the dictionary. The same authority is mainly responsible for the tests given in the general text in this work under the headings of the various poisons.

The universally adopted preliminary processes for the extraction of **metallic poisons** are two, known as the wet and the dry process respectively. Inasmuch as arsenic and antimony and mercury are far and away the most common metallic poisons, and as they all happen to be volatile at comparatively, for combustion, low temperatures, the wet process is certainly to be preferred in cases in which no clue exists as to the metal to be sought. On the other hand, if silver be known or suspected to be present the ordinary wet process will not succeed. For lead and tin and other heavy metals the dry process is as good as the wet (*vide* caution under "Tests for Arsenic").

The **Wet Process** consists in boiling the organic material with strong hydrochloric acid and chlorate of potassium and water till a clear yellowish solution is obtained. This contains the metal in "solution as a chloride," to which the usual tests for individual metals may be applied.

The **Dry Process** consists in burning the material in a platinum dish at as low a temperature as will serve the purpose. The resulting ashes are extracted with strong nitric acid and filtered. The metal is thus obtained in "solution as a nitrate," and can again be tested for by the ordinary methods (*vide* caution under "Tests for Lead").

6. **If Poison was found, was it Pure or Mixed?**—This question may be put to confuse an expert witness or to see what his chemical knowledge may be in regard to the chemical relationships of any poison. It may have reference also to the presence of soot or other colouring matter showing the commercial source of the poison.

7. **What was the Strength or Percentage of Poison found and also the Absolute Quantity?**—Obviously important questions with reference to the dose required of the poison either to kill, to be a "noxious thing," or to annoy. It may also have an influence on motive.

Again, the importance of the answer would be very much affected by the locality where it was found, *e.g.*, in a vomit in an external article, or in an organ such as liver or brain.

8. **What is the Dose necessary to Kill?**—*Ab initio* this is a matter of speculation and experiment on animals, but later becomes a matter of record from previous cases. We have already (pp. 311 *et seq.*) drawn attention to the difficulties of dosage as a matter of exact scientific proof. In court the minimum dose, known to have been swallowed by a person who died as the result of the dose, is accepted as the minimum fatal dose.

9. **In what Organs or in what Material did you find it?**—This has a strong bearing on the previous two questions. If the poison is only found in the contents of the stomach, and none in the viscera, and is not an irritant, grave doubts may be thrown on the statement that it was the actual cause of death. Poison found in a viscus (other than

the stomach or intestine) is proof of absorption; hence the importance of keeping the contents of the alimentary canal in a separate receptacle to that in which portions of solid viscera are kept. Poison similarly found in urine is, unless added from malice, also proof of absorption and excretion. Again, some organs have a special affinity for certain poisons, the brain for lead, for example. If it were also found in the food or medicine preserved, but which had not been swallowed, this would be very strong corroborative evidence indeed.

10. **If it was not a Poison, was it "Noxious"?**—It is in answer to this question that attempts at the definition of a poison are so frequently made. (The reader is referred to pp. 304 *et seq.*)

11. **Could the supposed Poisonous Substance exist naturally or be produced within the Body by any process of Decomposition?**—This is a very important question, but one easily answered in the case of such known definite alkaloids as morphine, coniine, digitaleine, atropine, strychnine, etc. They could not, by any means known to experience or science, possibly be manufactured in the body from either its own tissues or from any food product, and their presence is incontestable proof of administration. The question is not so easy to answer when ptomaines[1] or leucomaines[2] are found in the process of extraction of alkaloids and are alleged to have been the cause of death, and in such cases something will depend upon the poison, or alleged poison, being found in the contents of the stomach as opposed to the tissues of the viscera, but much more will depend on the symptoms and circumstances surrounding death (vomiting, purging, relation to food, etc.), already considered. Dr. Bulloch finds that these bodies, *apart from the microbes that produce them*, are very little poisonous.

When metals are found in very minute quantities it again becomes a little difficult to swear that they could not have found their way in as constituents of foodstuffs, though they may not be natural constituents of the body. Thus copper and arsenic in the minutest traces have been discovered in corn; the latter too (since the Manchester outbreak of beer poisoning) has been shown to exist in many unsuspected places. The objection is, however, more theoretical than practical, for in all cases of a suspicious character they are found in fractions (or more) of a grain too large to be accepted as arising from such sources, especially when the symptoms are taken into account.

12. **Could it have been present in the Reagents employed in Analysis?**—This, especially as regards arsenic and lead, is a very proper question for defending counsel to put; the well-known fact that these metals are frequently contained in commercial chemicals (especially acids) should put an analytical chemist on his guard, and nothing but gross carelessness could account for their presence in reagents used for such delicate work as that now under consideration.

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[1] *Ptomaines* are basic (*i.e.*, with powers of combination with acids to form salts) bodies produced in the process of splitting up complex animal tissues into their ultimate simplest possible products (CO_2, H_2O, and NH_3); they are practically equivalent to cadaveric alkaloids.

[2] *Leucomaines* are essentially the same products, but produced by and in the actions of the living natural tissues, instead of by the agency of microbes in vitro.

13. Was it possibly due to a Preservative employed on the Body?—It is this question which makes it so necessary to be careful about saving portions of the body for analysis without the use of antiseptics. Carbolic acid, corrosive sublimate and other mercurial preparations, chlorinated lime, etc., may all very easily confuse the result, and so may arsenic in paper used for wrapping up viscera (*vide* case on p. 350, *ante*). If the body has been artificially embalmed or definitely injected for preservation, the fact will be obvious.

There are few reports in which answers to many of these questions (even if not formally put) will not be required; and unless the whole of them are borne in mind by the operator at the time an analysis is undertaken, those which are omitted can never receive an answer, however important to the ends of justice that answer may ultimately become.

As a fitting summary of the foregoing discussion on poisoning in its medico-legal aspects the editor makes no apology for inserting an almost verbatim report of a case that occurred in 1903, with a few marginal comments (*R.* v. *Klosowski or Chapman*).

Severino Klosowski (36), alias George Chapman, was indicted for, and charged on the coroner's inquisition with, the wilful murder of Maud Marsh (C. C. C., March, 1903).

A legal point of evidence.

For the defence it was submitted that the prosecution were not entitled to prove the deaths of any other women at previous dates, and which were alleged to have been brought about by the prisoner, as he was separately indicted for them. Counsel referred to *R.* v. *Winslow* (8 Cox's Criminal Cases) and *R.* v. *Oddy*, before the Privy Council in 1893, and *R.* v. *Makin* (Appeal Cases, 1894). The Solicitor-General submitted that he was entitled to open the facts and give evidence of the death of other women with whom the prisoner had lived, and submitted that the case of Winslow had been overruled. He quoted *R.* v. *Gill* (18 *Law Journal*, Magistrates' Cases, p. 66) and *R.* v. *Flemington* (15 Cox, p. 403), and also the case of Neil Cream. Mr. Justice Grantham ruled that the evidence was clearly admissible.

Evidence of identification of the prisoner and of intent.

As the prisoner had lived under at least two names, evidence of identification was here of cardinal necessity. The evidence not only identified the man, but proved that he was well acquainted with drugs, which was a point of importance.

Evidence of adhesion to Pharmacy Act; witness not bound to incriminate himself.

The next evidence was the purchase by the prisoner in 1897 of an ounce of tartar emetic, and here the chemist who sold it had to show and did show that he took *all the* precautions required under the Sale of Poisons Act.

Evidence was then given to prove an alleged marriage of the prisoner to the victim, and also that in July, 1902, the victim was in hospital with similar symptoms to those of which she died. [In October, 1902, the fatal illness began, the main symptoms being vomiting and abdominal pain and excessive thirst; these recurred whenever she took drink prepared by the prisoner, and he prepared, or had access to, all her food.]

Evidence showing how easy it is to overlook a case of poisoning that does not end fatally.

Dr. Targett gave evidence to the effect that her illness in July was attributed to peritonitis, and that she had fever (102° F.), and that therefore antimony could hardly be suspected to be the *whole* cause of her illness at that time, even if other circumstances had suggested it.

Evidence showing the value of a consultation, and how

Francis Gaspard Grapel: I practise at West Croydon, and have been the medical attendant to the Marsh family for some time. On Tuesday, October 21st, Mr. Marsh called on me, and in consequence of what he said I went about 3 or 4 p.m. to the "Crown"—I saw the prisoner and told him that I was a medical man from

Croydon, and had come to see Dr. Stoker in consultation about his wife—he said there was a doctor already in attendance, and something about fifty others—I could not distinguish exactly what he did say—I asked to see Mrs. Marsh—I sat in the bar and then saw Dr. Stoker, and together we examined the deceased—her skin was sallow, jaundiced, and muddy in appearance, her tongue coated, her pulse fairly quick, her breathing shallow—she was in a semi-comatose condition—I examined her stomach—it was extremely tender to the touch—when I touched it she groaned and retched—I had a consultation with Dr. Stoker downstairs, and then saw Mrs. Marsh—before leaving the house I asked for and was shown some of the vomit—it was green—Dr. Stoker and I were of the opinion that she was suffering from some acute irritant poison, probably ptomaine—later on the suspicion crossed my mind that it was not ptomaine poisoning, but repeated doses of arsenic—I formed that opinion before there was a post-mortem—after I heard of her death I sent a telegram to Dr. Stoker.

suspicion may arise, and doubt of course of action when suspicion alone is present.

Cross-examined: It crossed my mind that it was arsenical poisoning on my way home—I did not go back and tell Dr. Stoker or send him any communication until after she was dead—bringing in a diagnosis of repeated doses of arsenic is tantamount to accusing someone of murder, and I had no proof whatsoever—I did not believe she was likely to die then—I was going to communicate with Dr. Stoker next day—the prisoner sent for the doctor—he did not put the slightest obstacle in my way of seeing the deceased—it did not strike me that he seemed anxious—I did not question him about the symptoms—he said she had been suffering from constipation—He did not tell me how she had been treated—I did not say more to him than I could help—on the Wednesday morning I told Mr. Marsh that I was going up to London as early as I could on that day to see Dr. Stoker, with the idea of having the excreta saved and examined—I did not examine Mrs. Marsh—I heard of the rabbit—I think it was Mrs. Marsh who told me that her daughter had been poisoned by a rabbit, and also the servant—I afterwards told the father that you did not get arsenic in a rabbit—it did not occur to me to investigate the story of the rabbit—I did not feel justified in at once telling the father what my suspicions were—even a doctor must have time to think about a case before he renders himself liable to anything legal—I did not take part in the post-mortem.

Evidence showing how a doctor may be, and is, imposed upon, but it should have aroused suspicion.

James Maurice Stoker: I practise at 221, New Kent Road. On October 10th, about 5 p.m., the prisoner called at my surgery, which is about half a mile from where he lives—he said he wanted a bottle of medicine for diarrhœa and vomiting—he led me to believe it was for his wife—he said she had been at Guy's, suffering from the same thing—he said she was not his wife, but she passed as such—I gave him a bottle of medicine; it was catechu, chalk, bismuth, and opium—the same evening about 10.30 I went to the "Crown"—I found the deceased in bed on the second floor—the prisoner went into the room with me—the deceased said she was suffering from diarrhœa and vomiting, and great pain in the stomach—I examined her stomach—there was great pain and tenderness all over the abdomen—I told her to continue taking the medicine I had sent, and said she was to have no solid food, but to go on a milk diet—I ordered her soda-water and milk, boiled milk, brandy, beef-tea, and ice—I ordered the ice to stop the sickness—she did not complain of any great thirst then—I went to see her the next day—the prisoner again went into the room with me—she was no better—the prisoner then said that she had been treated at Guy's, but they did not quite understand what was the matter with her there—the deceased told me that they had said she had peritonitis—the symptoms she complained of would be consistent with peritonitis—I saw her again next day (Sunday)—she was very much better—I changed the medicine and gave her bismuth, morphia, and ipecacuanha; that was for the soothing of the stomach

Suspicious symptoms continuing.

—I saw her again on the 13th; she was then as bad as ever—she had diarrhœa and vomiting; I saw them both; they were mixed together; it was an ordinary yellow-brown mixture—I saw her again on the 14th; she was no better—about the fifth day I noticed she had spasms—they came on with great pain in the stomach; she got rigidity of the muscles of the leg; they passed off in about half a minute—they did not synchronise with the sickness—they came on independently—on one occasion she had two in about five minutes—I could not then form an opinion as to what caused them—I saw her again on the 15th; she was no better—I asked the prisoner if she was having the milk diet, and he led me to believe she was having all I ordered—there was no one else to ask—I was not there when anything was administered—she was very much worse on the 15th; and on that day I stopped all food through the mouth except the bismuth powders—she could not even keep the medicine down—I ordered her to be fed by injections through the rectum—she was to have egg, milk, and beef-tea as a mixture—I could not then form any opinion as to what she was suffering from—I thought the symptoms might be those of gastro-enteritis, which is inflammation of the stomach and bowels—at that time I had not the slightest suspicion of any foul play—I suggested to the prisoner that she should be taken to the hospital, but the deceased objected and began to cry—I then suggested a nurse, but the next day, finding there was still no one there, I spoke to the prisoner about it—he said he had tried to get one, and that she would come on the following day—on this day I found that the deceased could not retain the bismuth powders—they were to allay the irritation of the mucous membranes of the stomach—I stopped them and advised her to be fed entirely with the injection—I got beef-tea suppositories and told the prisoner to give her everything iced—I do not know whether up to that time she had had any injections—on Friday I saw the nurse, Toon, for the first time—I gave her directions about the food and injections—I did not know if she knew anything about giving injections—the prisoner was there when I gave Toon the instructions—I thought Toon was carrying out my directions—I called again on Saturday, the 18th—I found the deceased very bad, vomiting and diarrhœa—I saw the vomit; it was slimy and green; the green would be due to the irritation of the stomach and gut—I do not think I visited her on the Sunday; I know I missed one day—the next time that I saw her after the Saturday I found her much weaker and with the same symptoms—I asked the nurse about the injections—she told me she did not even retain these—I told her she ought to reduce them to half the quantity to try if she could retain any liquid—the prisoner was there when I said that—I had no idea that it was the prisoner who was giving the injections—I was sent for to meet Dr. Grapel—the prisoner was not present—the deceased was very weak and semi-unconscious—I had some conversation with Mrs. Marsh on the landing about the death certificate on the Monday—I called on the Wednesday about 3 p.m. and then heard that the deceased had died at 12.30 — a message had been sent to me, but I did not receive it, as I was out visiting—when I saw her on the Tuesday I had no reason to anticipate that she would die so soon—on the Monday she was about as bad as she could be, and I could not say if she would get well—on the Wednesday I asked when the deceased had died—I was told—I then went out on the landing and had a conversation with the prisoner—I said I should like a "P.M.," as I could not account for the cause of her dying—he said, "What use is it?"—I did not say anything about the certificate then—I went back into the room with him—Mrs. Marsh was there—I told her that I wanted a "P.M." as I could not account for the cause of death—she said, "I must leave it to her husband"—I said that I did not know what was the cause of death, and I might be asked what had caused her death—the prisoner said that she had died from

Evidence of the right thing to do when suspicion is aroused.

exhaustion—I asked what caused the exhaustion—he said, "Diarrhœa and vomiting"—I asked what caused the diarrhœa and vomiting, and he made no answer—I said I could not give a certificate for her—I would have to have a "P.M." or an inquest—I told the prisoner I only wanted a private post-mortem, just to satisfy myself as to what caused the diarrhœa and vomiting—I then said I should have to make arrangements for the removal of the body to the mortuary, and I went to the proper authorities and the mortuary keeper—the body was removed early the following morning—on October 23rd I made a post-mortem examination with Dr. Cotter—I examined the liver, the kidneys, the lungs, and the ovaries—they were healthy—I examined the intestines and the stomach externally—I could not arrive at any opinion as to the cause of death—I did not see anything to account for the symptoms causing death—I had taken two glass bottles with me when I went to make the examination—I had taken pains to see that they were chemically clean—I removed the stomach and its contents from the body without opening it—I tied it up and put it straight into one of the bottles—I also removed portions of the rectum and the liver, and put them into the other bottle—the deceased was not pregnant—there were no traces of pregnancy or any affection of the womb—I took the bottles away myself and sealed them up, and next day took them to Dr. Bodmer, of the Clinical Research Association—I got a communication from him in the evening, and then I had a consultation with Dr. Cotter, and as a result in the early morning of Saturday, the 25th, I communicated with the police—after the prisoner was arrested I saw these bottles of medicine (*produced*) which I had sent to the deceased—I make up my own medicines—I made these up—this small one had opium and water in it; that is a sedative; that was for injection to relieve the pain in the rectum—I cannot fix the date that I ordered that—this other bottle, I should say, had bicarbonate of soda and prussic acid in it—I did not put any antimony or tartar emetic into any of them—I do not keep any antimony in my surgery—I had none at this time—I have had none for ten years—I do not know if antimony now is an accepted medicine; I do not know much about it—I never use it—I keep a preparation of arsenic—I did not put any arsenic in the medicine—I think these are some of the bismuth powders I prescribed (*produced*)—I had some of it remaining in my surgery after the death of the deceased—I handed it to Inspector Godley with a view to it being analysed—I was present at the post-mortem made by Dr. Stevenson.

Correct procedure in a suspicious post-mortem.

Correct action when suspicion made a certainty, or nearly so;

Evidence rebutting suggestion that poison might have been in medicine.

Cross-examined: I have been in practice ten years in London, and have had a good many cases of ptomaine poisoning, but not of arsenical or antimonial poisoning—I have never had a case where poison had been deliberately administered—this is my first experience of a case of this kind, and I hope it will be the last—I know that tartar emetic is in the Pharmacopœia as a medicine; I have never had occasion to employ it—I have never had any practical experience of the tartarisation of antimony—I do not think I should recognise it if I came across it in a post-mortem—if antimony was present in the deceased's stomach when I took it out and placed it in the glass jar I should not recognise it—I do not put myself forward as having any special knowledge on that subject—I should not have analysed the deceased's vomit myself—I should not have tried to trace the presence of antimony—the prisoner did not in any way object to my making an examination of the vomit or the excreta—I could have taken it away for examination; the vomit was only unusual because it was green, but not more so than you would see if the patient was suffering from a bilious attack—I have constantly seen vomit as green as that—I did not see any blood in it; it may have been there when I did not see the vomit—I only saw it on two occasions—I only saw the fæcal matter once—I saw no blood then—I prescribed altogether six five-grain bismuth powders—I am not aware that bismuth gives rise when tasted to the same burning

Cross-examination to destroy witness's reliability, but he very correctly assumed no special knowledge. Note how he was questioned on his knowledge of drugs.

sensation in the throat as is alleged with regard to antimony—I do not know if it gives rise to a metallic taste—I have often taken bismuth, but never tasted it—I have taken a piece on my finger—I have never had a case of poisoning from bismuth—I know there are such cases, but you want an enormous quantity—you can get diarrhœa and vomiting from an overdose of bismuth—you might get spasms in the arms and legs—I do not know if you would get inflammation of the throat, windpipe, and gullet—I prescribed the ipecacuanha in three minimum doses—I should say about sixty minims would give rise to a sense of sickness—I have never known ten or twelve minims doing so—the ordinary dose goes up to ten—some people are more sensitive than others—I did not keep any record of the medicine I prescribed—I never do so except with a patient coming into the surgery—I do not enter in a book the medicines I send out—I put down the visits I make—it is not unusual to have no record—I am almost certain that my memory is accurate as to what I gave the deceased—the beef enules came from Burroughs & Wellcome—the patient generally gets the nurse; the prisoner had no objection to having one—I did not know what Toon's experience was—I did not think it necessary to satisfy myself that she could carry out my instructions—I thought the prisoner would get a good nurse because he knew what had to be done—I should not as a rule witness the injection—the prisoner asked me to call and see the deceased—I did not suggest to him during the last twelve days that he should call in another doctor—I did not know Dr. Grapel—the prisoner was not present at our consultations—I was in consultation with three or four other medical men in connection with that matter with the prisoner's consent and approval—he paid the fees—I was always under the impression that any suggestion of mine with regard to food was carried out—he appeared to be kind and solicitous to his wife—she appeared to be fond of him—I had never the slightest idea of anything being wrong—the vomiting and diarrhœa were consistent with my experience of gastro-enteritis—I should have been perfectly ready to give a certificate to that effect.

Value of records of all cases.

Re-examined: I did not think of submitting the vomit to chemical analysis because suspicion was entirely eliminated from my mind—I had no idea of any irritant poison; it would not be possible for me to recognise antimony when examining a body—it would have to be submitted to a chemical analysis or to somebody with more experience than I have—I have never seen a case of poisoning by bismuth; I have read of one—there has not been a case in recent years—the number of grains in a case I read of was very great; at that time bismuth had arsenic in it—the bismuth in my surgery was found perfectly pure—a five-grain dose of bismuth is a medium one—I was prescribing it with a view to allay the vomiting—it is a well-known remedy for doing that—I have never heard of these small doses causing vomiting or irritation—it always has the opposite tendency—I use about half a pound in a fortnight—I did not know whether my instructions as to diet were carried out or not.

By the Court: I know Bessie Taylor died at the "Monument"—her symptoms were something similar to those of Maud Marsh—even that did not make me think at first that I ought to have further inquiry.

Evidence of identification of jars and preliminary testing to corroborate suspicion.

Further corroboration

Richard Bodmer: I am a Fellow of the Institute of Chemists and Public Analyst for the Borough of Bermondsey—I am consulting chemist to the Clinical Research Association, 1, Southwark Street—I received two sealed jars from Dr. Stoker—one of them contained a human stomach and a small piece of human liver—the other contained a lower part of the bowel and some pieces of liver—I had a conversation with Dr. Stoker, and in consequence I applied some tests in order to discover whether there was any arsenic present—the stomach was tied at both ends, and on opening it I found its contents were from about one and a half to one and three-quarter ounces of a yellow gruel-like fluid—I applied Reinsch's test to a small portion of it; that is a well-known test for arsenic—I discovered arsenic was present—some slips of copper are used in the test; they became a purple colour, indicating the probable presence of antimony in addition to arsenic—I communicated what I found to Dr. Stoker—on Monday, October 27th, Inspector Godley saw me, and in consequence I subjected another portion of the contents of the stomach to Marsh's test, which is also a test for arsenic and antimony—I discovered both present by that test, and also found that there was far more antimony present than arsenic—I did not open the second jar—I replaced the stomach in the first one, and a part of it which I used in my tests I placed in a perfectly clean glass-stoppered bottle, and on October 28th I handed all three jars to the coroner's officer.

and care of cleanliness.

Cross-examined: The violet deposit suggested antimony to me—it is not always a conclusive proof of its existence—other substances will hardly produce the same colour, but something which might be taken for it—I have not read a report of Pritchard's case in 1865—I cannot at present remember any other substance which would produce the same violet colour—sometimes arsenic will come out and almost look like antimony—I do not only rely on the colour of the copper—I subjected the copper to a cleansing process before I used it.

Cross-examination of expert to try to find incorrect inferences.

Joseph Henry Vaughan Marks: I live at 31, Gaywood Street, and am coroner's officer for Southwark—on October 25th I got some information and went to the police-station, and an inquest was opened on the body of Maud Marsh on the 28th—that evening by the coroner's order I went to Mr. Bodmer and received from him three jars—I took them to my house and kept them there till October 30th, when I gave them in the same state to Dr. Stevenson.

Not medical, but important, evidence *re* identity and safe custody of objects for analysis.

Thomas Stevenson, M.D.: I am one of the official analysts to the Home Office, and also Lecturer on Forensic Medicine at Guy's Hospital—I have had experience in analysis, particularly with reference to poisons, and have acted for the Home Office for thirty-one years—on October 30th I attended St. George's Mortuary to make a post-mortem examination on the body of Maud Marsh—Dr. Freyberger, Dr. Stoker, and Dr. Cotter were there—there had been a previous post-mortem—the body had been dead fully eight days, but there was not much decomposition, much less than I should expect in a body so long dead, considering the time and season—the scalp covering the skull was dry; that indicated that there was little fluid in the tissues—the skull and brain were normal—there was no hæmorrhage or disease in the brain—the spinal cord was normal, and no sign of disease there—the tongue was yellow, coated, and swollen—the air passages to the lungs were quite clear, and the lungs free from disease—there was a good deal of fat about the heart, but that would not have affected her health much, unless it had gone much further—it had invaded the muscles to the extent of about one-third—the mesenteric glands were much swollen—the stomach had been taken away, but it was given to me by the coroner's officer before the end of the post-mortem—the bloodvessels of the bowels were unusually red and injected with blood, but not to a very marked extent—the mucous membrane of the bowels was swollen and slimy, and was in the condition which we generally know as sub-acute enteritis, which is inflammation of the membrane lining the bowels—there was a good deal of liquid in the bowels, but only a little semi-solid fæcal matter, which was about the sigmoid flexure of the colon—one of the glands showed that she had probably been a person subjected to habitual constipation—the whole of the rectum had been removed—I found no ulceration of the bowels—I examined the pancreas, the spleen, and the kidneys; they were all sound and healthy—the liver had been detached, but it was in the abdomen—a small portion had been removed—it was rather dry and greasy, but there was no condition which would affect her health materially—I examined the womb and ovaries—they were perfectly normal—she had never apparently borne a child, nor were there any signs that

Evidence of the expert on the post-mortem and analysis, ranging even to the first doctor's drugs, illustrates the wide and accurate knowledge required of a toxicologist. Note his cross-examination.

she had been far advanced in pregnancy—menstruation was just upon ceasing—I found no evidence of any natural disease which would account for her death—I suspected that she had died from some form of irritant poison, which had set up enteritis—I had heard of the question of arsenical poisoning, but I came to the conclusion on making the examination that it was not arsenic, but some other metallic poison—I then removed the brain, some blood from the cavity of the chest, the spleen, the gall bladder, which was full of bile, the liver, the kidneys, the contents of the bowels, the bowels themselves, and also some blood from the abdominal cavity—they were all rather light in weight—the drain on the fluid caused by the vomiting would account for that in a great measure—on the 31st I examined the stomach from the jar—there were signs of putrefaction externally and internally, it was pink and injected with blood—the bloodvessels were prominent and redder than usual—internally it was coated with a good deal of yellow slimy mucus, which became an orange colour at the bowel end—I did not find any ulcers or loss of substance—I examined the contents in the stomach and portion of the liver and rectum in the jars—I made an analysis of various parts of the body—every portion of the body which I examined had antimony in it—I found antimony in the stomach and its contents, in the bowels and their contents, in the liver, bile, spleen, kidneys, the fluid which I took from the abdominal cavity, in the blood from the cavity of the chest, and in the brain—I made tests for arsenical poison—I found traces of arsenic in a small quantity, and I formed the opinion that death had not resulted from it—arsenic is sometimes found in antimony when it is impure—I came to the conclusion that death was caused by poisoning with antimony in a soluble form—that was tartar emetic or metallic antimony—that is one of the scheduled poisons—I did not find any bismuth there, but the tests for bismuth are not so complete—if there was any it must have been infinitesimal—I have never heard in late years of a case where bismuth has caused such symptoms as these, or caused death—bismuth is now purified from arsenic and other impurities—five grains is an ordinary dose—in the cases I have heard of where death was caused by bismuth I think that 120 grains must have been taken—I found no trace of impure bismuth in this case—I found 0·23 grains of metallic antimony in the contents of the stomach, 5·99 grains in the contents of the bowels—that indicated to me that there must have been a large dose of antimony given within a few hours of death, as it is soluble in water—it had not been got rid of by purging or vomiting—in the liver I found 0·71 grain of metallic antimony, in the kidneys 0·14 grain, in the brain 0·17 grain, in all 7·24 grains, which is 7¼, the bulk of which was in the bowel—I deduce from that that there was a good deal more antimony in the body—antimony can be made soluble in the form of tartar emetic or emetic tartar, which is a white powder, soluble in water—it does not change the appearance of the water—emetic tartar is not altogether antimony—7·24 grains of metallic antimony would represent 20·12 grains of tartar emetic—the proportion is roughly three to one—I did not calculate the amount of tartar emetic in the whole body, but from my experience I should put it at between twenty-five and thirty grains—when tartar emetic or antimony is administered as a rule the greater part of it is very quickly ejected—purging relieves it—the effect of the poison itself generally takes a very considerable time before it causes death—death has occurred in many cases where it is given in repeated moderate doses—vomiting and purging makes people waste away—it produces gastro-enteritis, and they also appear to die from failure of the heart—antimony depresses the circulation—it quickens the pulse, but gives it a very feeble power—two grains of tartar emetic has killed, but that is not ordinary—I should put the ordinary fatal dose at probably fifteen grains—others put it at ten—even that might not be fatal if the greater portion of it is vomited—people have taken tartar emetic in much larger quantities,

Close examination on symptoms of the alleged poison.

and have recovered where it has been quickly vomited—I am of opinion if two or three grains were given repeatedly to a healthy person that it would eventually cause death—when doses of antimony are given from time to time the symptoms are great depression, profuse perspiration, followed by nausea and vomiting—purging is set up with pain in the abdomen, and usually after a time there is a burning or metallic sensation in the throat and stomach—there is a great thirst—spasms are quite common, and patients fall sometimes into a comatose or semi-comatose state—they are generally very pallid, and sometimes they get quite jaundiced, and dark under the eyes, and thin and worn—it is sometimes the appearance, apart from other symptoms, which indicates that the patient is approaching death—in the case of Mr. Braywood it was his appearance which excited the suspicion that he would die—Sir William Gull and others who saw him, although he was apparently going on well, thought afterwards he could not get on so well—that was a case of poisoning by tartar emetic—if tartar emetic is taken in a strong solution it has a somewhat metallic but sweetish taste, but when taken diluted it does not have much taste—it can be covered up by food or medicine —people take antimony wine, which is sherry with antimony in it, and yet not know that anything is wrong—if doses had been going on for some time so as to set up irritation of the mucous membrane, that would set up the burning feeling in the throat—antimony can be dissolved and given by injections, or put into injections—that would be very dangerous: it would be quickly absorbed into the rectum and then into the body—the vomit in a case of poison by antimony would be at first the contents of the stomach, and then it would become green or yellow—I got a great number of bottles from Sergeant Kemp—I examined them—there was antimony or arsenic in one of them—some of them had contained photographic chemicals—I examined the bismuth powders found in the room, proved to have come from Dr. Stoker—they were free from antimony and arsenic—I also examined the bismuth from Dr. Stoker's surgery —it was pure and a very good specimen—these two bottles which contained medicine had no trace of antimony or arsenic—this other one had two or three drops at the bottom of it—I do not know if it had been washed out—I found bismuth and antimony in it—I should say there was quite as much antimony as bismuth in it—there was enough antimony to give several full doses—emetic tartar can be dissolved in water so as not to be apparent, and then could be mixed with a bismuth preparation—tartar emetic is also soluble in brandy—brandy of ordinary strength will take up about two grains to the ounce—a tablespoonful of such medicine would be a full emetic dose—it is much more soluble in brandy and water than in plain brandy—these two bottles contain brandy and water, two parts water to one part brandy—there is tartar emetic in one of them—this one, which contains about an ounce, is probably a fatal dose—I could find nothing to account for death except poison by antimony —antimony might be given to produce perspiration and for bad colds, but only from one twenty-fourth to one twenty-sixth of a grain to a dose—half a grain to a grain would be an emetic—death would not ensue from one dose of that strength or cause great pain—if vomited, it would not produce diarrhœa—all the signs I found at the post-mortem would not be caused by such doses as that.

No other cause for death.

By the Court: When I said I could find nothing to account for death except poisoning by antimony, I meant antimony administered for the purpose of poisoning.

Cross-examined: There was not enough antimony left in this bottle for a fatal dose—if the bottle had been full of the same preparation of bismuth, antimony, and water, I think there would have been sufficient for a fatal dose, but I am not positive—it contained six doses—each dose of itself would not be a fatal one, but I cannot say what would be the effect of six successive doses—I should expect a person to be very ill after taking them—I examined the syringes

—one of them is covered with an insoluble preparation of antimony, which is used in its manufacture—apart from that I do not find any trace of antimony on either of them—I heard that they were used for the injecting of liquid beef-tea, but also that they were soaked and washed afterwards—the immediate cause of death was subacute gastritis—I have had to do with a good many cases, but I never saw such extensive gastro-enteritis from ptomaine poisoning—it generally produces more inflammation of the bowels than of the stomach—in this case the stomach was worse than the bowels—persons who have died from ptomaine poisoning suffer from subacute enteritis—it is a question of degree—the fat which I noticed round the heart might point to old alcoholism, but fatty degeneration of the heart is well known in poisoning—the deceased was a very young woman to have had a fatty heart from alcoholism—tartar emetic is sometimes used as a check to drinking propensities—it nauseates the patients so that they cannot indulge in drink for the time being—in former times bismuth contained impurities which, apart from the bismuth itself, gave rise to arsenical poisoning; but at the present day bismuth is cleansed from those impurities, and is not itself poisonous—there have been cases on record of bismuth poisoning where the dose was only two drachms—I have edited Taylor's "Medical Jurisprudence" —a metallic taste, vomiting, and purging, spasms in the arms and legs, which occurred in a case of bismuth poisoning, would coincide with a case of poisoning by antimony; but in a paragraph in my edition of Taylor I think that that is explained—my reason for saying that I did not attribute the poisoning to arsenic was because the quantity of arsenic was very small, and it was present only in the contents of the stomach and bowel, and in the liver, but I could not detect any in the more remote organs, and if a person died from arsenical poisoning I should expect to find arsenic generally distributed through the body—there was not sufficient arsenic to make me attach any importance to it—I ascertain its presence in various ways—the colour of the copper foil in Reinsch's test is very significant—arsenic, antimony, bismuth, and mercury give very much the same colour, but none of them give the particular effect of antimony, so far as I know, and, of course, one does not rely on that one simple test alone—my tests are absolute, and not only probable —I discovered some orange sulphide, which was soluble in hydrochloric acid, and separating it and treating it by Marsh's process, it was proved over and over again beyond all doubt to be antimony —that colour is not common to other mineral or vegetable poisons— putrefaction had only just commenced in the body of the deceased at the time of her death—there was only one day when the temperature rose above 50 degrees—I keep a record—I was engaged in the Bravo case, which was a case of poisoning by tartar emetic—I did not see the vomit in that case, but probably it contained blood—the purge contained blood, but it is not invariably present in the vomit and purge in cases of antimonial poisoning—I have not personally had a case where a person who died of antimonial poisoning vomited or purged blood—Bravo passed blood the same night that he had the antimony—I was at the inquest in that case—there are cases where there has been no vomiting of blood.

Caution of quotations from books.

Re-examined: The question of blood in the stool would be according to the amount of the irritation, and in the fæces the blood might not appear as blood, but as a black stuff—to an unskilled person it might not appear to be blood—if the motion was black it would probably indicate that there was blood—if I as a medical man wished to know whether there was metallic poison, I should look to see if there was blood in the fæcal matter—these glass tubes contain antimony in a sulphide form which I took from the deceased's body —here are some in the metallic form—the shining portion is the sulphide from the bowel—all the bismuth coming from Dr. Stoker was pure, and did not contain arsenic—I have no reason to think that the deceased was addicted to drink—I never heard it suggested

Cross-examination on other possible cause of death.

until now—there was nothing in the fatty degeneration of the heart that would cause death—I daresay I have a much fatter heart than she had—it would not have produced vomit nor gastro-enteritis—the main poisoning could not possibly bring about the production of antimony by any internal process—if the syringes were soaked in water, that would get rid of any traces of antimony—there would be no difficulty in mixing the antimony with bismuth if you dissolve it in water first—you could also put it into the bismuth without dissolving it.

By Mr. Elliott: Bismuth taken by the patient produces black motions.

By the Jury: There was less antimony in the rectum than higher up in the bowel—I cannot say if the whole of the last dose of antimony was due to rectal administration, but I think that she must have had during the last few hours of her life some given by the mouth—if the brandy was pure it would not take up enough antimony to give it any extra taste; but I should not like to take a mouthful of this brandy and water and antimony.

Shows a witness answering questions by jurymen more or less to the point.

This finished the actual case of Maud Marsh, with the poisoning of whom the prisoner was charged, but evidence was then taken with regard to another woman with whom the prisoner had lived previously. The evidence here again, from a medical point of view, is most instructive.

Thomas Stevenson (*Re-examined*): I attended at St. Patrick's Cemetery, Leytonstone, on December 9th, 1902, and examined the body in the coffin bearing the name-plate of Mary Isabella Chapman, who died on December 25th, 1897—I saw the lid removed—the body was altogether remarkable—the face and head were those of a woman who might have been coffined that day from the appearance—even the eyes were unruptured, a very unusual circumstance—there was not the least difficulty in recognising her—the muscles had a fresh appearance—all the parts of the body cut rather leathery, like shoe-leather, and of course were drier than in a fresh body—all the parts of the body except the brain were preserved—the stomach was unusually pink externally—that was from the blood in the vessels being more than usually good—its inner coat was of a peculiar cinnabar red colour, and towards the bowel end there was a patch of black blood which had been effused—there was no sign of perforation or ulceration—there was no loss of substance in the mucous membrane—towards the bowel end there were some old scars of years' standing—the bowels were not ruptured—the tube was intact—internally the bowel had the same red colour as the stomach—there was no ulceration—the liver was pale, but firm in texture and fairly normal—the spleen, the kidneys, the bladder, the heart, and the lungs were all normal—there was no sign of phthisis; that generally indicates disease of the lungs—the cause of death was gastro-enteritis—there was no other cause—there was nothing to indicate that the woman had been a confirmed drunkard—if she had drunk it had not produced any serious injury to the kidneys or liver—the inflammation which I found in the stomach was not attributed to alcohol—I removed the stomach, the bowels, liver, kidneys, spleen, lungs, heart, brain, and some of the muscles, and submitted them all to analysis except the lungs—they all contained antimony—it had permeated to the muscle of the thigh—in the bowels I found 0·41 grain of metallic antimony, in the liver 0·87 grain, in the kidneys 0·06, and the stomach 0·03, which makes altogether 1·37—that would represent as emetic tartar 3·83 grains—there was more in her liver than I found in Maud Marsh's—that quantity points to a large amount of antimony having been absorbed into the body, and would indicate a considerable dose having been taken some hours before death or the continuous administration of small doses—the purging and vomiting would get

Proper identification in exhumation (*vide* Vol. I., p. 237).

Again, full knowledge of pathology required.

Preservative action of antimony.

rid of a good deal of the antimony—I came to the conclusion that the cause of death was poisoning by antimony, and I attribute the preservation of the body to the antimony—it has not been thoroughly recognised that preservation is one of the effects of antimony, but it has been found in previous cases to be a preservative—the fact of antimony being found in the muscles would not indicate that doses of antimony have been going on for some time, because I think it would quickly pass to every vascular part of the body; evidently the body had not been touched by water, the coffin and its contents being well preserved.

Attempts to suggest that burial (*vide* Sect. V.) influenced the condition of the body, and not antimony.

Cross-examined: The condition of preservation in a measure depends on the surroundings of the body quite apart from anything internal—it was an elm coffin—the grave was eighteen feet deep—the depth of a grave to some extent helps to preserve a body, but if this body had begun to decay at the time it was buried, the depth of the grave would not have retarded it—the air generally reaches a body before it is buried—this soil was very dry, clay and loam, which would assist preservation—it would take a few years for rain to get down eighteen feet—the grave was not a brick one—there were seven other coffins above; this one was at the bottom—the body was almost lifelike—bodies buried in lead coffins, when opened years afterwards, have been found to be preserved to a wonderful degree—in those cases the air had been excluded—a wooden coffin would not be hermetically sealed—the other bodies removed from this grave had a fearful smell—we did not open the other coffins; they were reverently put aside, and a tarpaulin put over them—the whole of them had been buried within a month—I did not analyse the lungs, because I was told the woman had died from phthisis, but when I found no traces I put them aside in case questions were asked—if I had not known the history of the woman, but was told that a certificate of death from phthisis had been given, I might possibly have found that consistent with her condition—when people die from phthisis there is generally great emaciation.

By the Jury: I am of opinion that antimony given in gradual doses for a long time would be more likely to preserve the body than a sudden dose—it would get more into the system.

R. Bodmer (*Re-examined*): I took part with Dr. Stevenson in making an analysis of this body—I have heard his evidence, and I agree with him.

Shows how even with four consultants no suspicion arose—not a very creditable performance.

J. M. Stoker (*Re-examined*): I was called to the "Monument" on January 1st, 1901—previous to that Bessie Taylor had called on me and asked for some medicine—I then attended her—I visited "Mrs. Chapman" almost daily from January 1st to February 13th, when she died—when I first called she was in bed; she had vomiting, diarrhœa, and pains in the stomach, which was very tender—the vomit was green—I cannot recollect if I saw her vomiting—I prescribed for her—she used to get better and then go back again—I suggested another doctor being called in—I had three separate consultations with three other doctors—one was Dr. Sunderland—he is a specialist in the diseases of women—he only saw her once—I was under the impression that "Mrs. Chapman" was suffering from some womb trouble—I do not recollect if Dr. Sunderland suggested any alteration in the treatment—she did not make any improvement—I then suggested another doctor—somebody in the house suggested Dr. Thorpe, of Southwark Bridge Road—he and I examined "Mrs. Chapman" together—he said he thought she was suffering from a severe form of hysteria—I then got Dr. Cotter—we examined the patient together—he thought she was suffering from some cancerous disease of the stomach or intestines—in consequence I sent a portion of her vomit to the Clinical Research Association, with directions to see if there was any trace of cancer—that would be a microscopical examination—they found no trace—the constant vomiting and diarrhœa continued more or less during the whole time I was there—I remember one evening going in and finding her playing the piano—I cannot recollect the date—she appeared very much better, and in consequence I said I would not call back again unless I was sent for—I do not recollect if I had any conversation with the prisoner on that day—I was sent for the next day—I found her worse than ever—I was with her the day before she died—she was very bad then with the same symptoms—I do not recollect whether on that day I thought she was dying or not—next day I heard of her death—I was asked to give a certificate, which I did, giving the cause of death as intestinal obstruction, vomiting, and exhaustion—intestinal obstruction would cause vomiting and exhaustion—she was suffering from vomiting and ordinary stoppage when she came to my surgery—diarrhœa would follow when the stoppage was cleared—I did not put the particulars in the certificate, "G. Chapman, widower of deceased"—I thought the prisoner was married to the woman—I never had such a thing as antimony at this period, and I never prescribed it.

Illustrates the ease of deceiving a doctor.

Cross-examined: I had seen Mrs. Stevens before—it was at her recommendation that I went to the Chapmans—up to that time I knew nothing of them—at first I regarded the case as one of constipation, and I directed my treatment with a view of removing that—I attended her at her home for excessive diarrhœa, so the stoppage must have given way—I think that she came to my surgery twice—I do not remember what I gave her, most likely a dose of salts—I next saw her at her home on January 1st, when I treated her for diarrhœa and vomiting—I do not know what I gave her then—I saw the prisoner—I do not remember if when I suggested to him that I should like further advice it was within the month—he at once agreed—I believe that Dr. Sunderland came to the conclusion that she was suffering from some uterine trouble—I have no record of it—I have not seen him since—the prisoner saw Dr. Sunderland when he came, and asked him what was the matter with his wife—I do not remember that he was dissatisfied with our opinion—he was willing to have a third doctor—he paid the fees—I consulted with Dr. Thorpe—I think he told the prisoner that the woman had hysteria—he accepted that opinion, as he had accepted Dr. Sunderland's—it was at my suggestion that a fourth doctor was called in, because the woman was getting no better—the prisoner agreed to that—I do not know what fee he paid in each case—he did not grumble—Dr. Cotter said it was some cancerous disease of the stomach or intestines—I think Dr. Bodmer examined the vomit that I sent—Dr. Cotter's opinion was not sustained—I do not think the report was told to the prisoner—I do not think the patient lived long after that—I had many opinions—I have no record of my treatment—if the specialist had suggested an alteration in the medicine I certainly should have made it.

Difficulties of diagnosis of poisoning.

Re-examined: None of us suspected poison.

By the Court: As far as I can tell, she was cured of constipation—you can get vomiting with hysteria, and you can imagine a lot when you have hysteria—I think Dr. Thorpe thought the woman was imagining—it did not occur to me that she was not suffering—constipation was the primary cause—the vomiting and exhaustion had caused her death—it would probably have been wise to have had a post-mortem before giving the certificate, as all the doctors were evidently wrong—I have never known a case where four doctors gave four different opinions, and when the patient died, still there was no post-mortem.

Vide Vol. I., Section II.

Dr. Stevenson (*Re-examined*): On November 22nd, 1902, I was at Lymn Churchyard, Cheshire, and I saw Bessie Taylor's coffin taken from the grave—it had a plate on it, "Bessie Chapman, died February 13th, 1901, aged 36 years"—the body was covered with a mouldy growth, but otherwise was fresh—there was no putrefaction and no odour—the tissues were dry—the muscles had a red and freshish appearance—there was a fæcal odour in the abdomen, but no putrefactive odour—although the features had mould on them, one could follow the shape and general contour—the breast was shrunken, and the whole body dry—generally when bodies decompose they become

Vide discussion on decomposition: "It is never too late to do a post-mortem."

wet and slimy—this was one extremely well preserved except for the superficial skin—I made an examination of the various organs—on the base of the right lung I found some old adhesions from old pleurisy—the lungs were shrunken and dry, but otherwise healthy and free from deposits or cavities—adhesions are quite common in people of good health in middle life and after—the heart and its valves were healthy—the stomach was empty, but its vessels were filled with dark blood to an unusual extent—on the inner surface of the gullet end of the stomach there was a patch about four inches in diameter of a cinnabar red colour which denoted gastritis—there was no ulceration or perforation or any loss of substance in the mucous membrane of the stomach—the cinnabar red colour extended more or less through the bowels, indicating enteritis—the inner surface of the bowel was coated with a yellow paint-like stuff, which was sulphide of antimony—the pancreas, spleen, kidneys, and liver were all shrunken by time, but otherwise normal—the womb, ovaries, appendages, and bladder were quite normal—I found no trace of cancer or uterine trouble—I could find no sign of any cause of death—I examined the brain—it was a good deal decomposed—there was no sign of hæmorrhage, or any recognisable disease—I found no intestinal obstruction—I formed the opinion that she had died from gastro-enteritis, which was due to some irritant poison—I removed the stomach, bowels, liver, spleen, kidneys, heart, brain, and lungs, and subjected them all to analysis and examination—the analysis showed that antimony was present in all those parts—there was no other poison—in the stomach there was 0·12 grain of metallic antimony, in the bowel 8·43 grains, in the liver 1·64 grain, in the kidneys 0·30 grain, making a total of 10·49 grains, which equals 10½—that represents of tartar emetic in the stomach 0·32 grain, in the bowel 23·43 grains, in the liver 4·55 grains, in the kidneys 0·82 grain, making in all 29·12 grains—I cannot find any recorded case of such a quantity having been found in the bowel after death—it suggests that she had some large dose not long before her death—I examined the earth about the coffin, but found no poison.

Preservative effects of antimony.

Cross-examined: The woman had been buried about twenty-one months—Isabella Spink had been interred practically five years—neither body was putrid—Taylor was covered with ordinary vegetable fungi—there were conditions about the body that I identified with the case of Spink—I compared Taylor's features with a photograph which I was told was hers, and I could recognise the general contour—the nose and cheeks had preserved their shape—I could not distinguish the eyes—there had been a change in her which was more remarkable than in the case of Spink, where there had been practically none—I think Taylor's body contained more antimony than Spink's—given the same conditons as far as the coffin and grave were concerned, I should have expected to find that a woman who had only been buried twenty months, and had more antimony in her body, to be less subject to change than a woman who had been buried five years and had less antimony—Taylor's coffin was a dry elm one, and, as far as I could judge, the body had not been contaminated by contact with the soil, which was very dry and sandy loam—putrefaction generally begins through the nose, mouth, and anus. and spreads outwards—there was none of that in either body—the superficial decomposition of the body was due to the growth of mould—the presence of antimony does not prevent the growth of moulds; in fact, they will grow in a strong solution of tartar emetic.

Verdict, "Guilty": death.

SUB-SECTION E.—CLASSIFICATION OF POISONS AND POISONING BY (GROUPS OF) INDIVIDUAL POISONS.

There is just as much difficulty in classifying poisons on any satisfactory and scientific plan as there is in defining what is a poison. They might for various purposes be classified in many ways, according to their origin; for instance, from the animal, vegetable, or mineral kingdom, or according to their mode of entrance to the body, or according to their physical properties, gaseous, liquid, or solid; but to each and all of these there are objections of greater or less magnitude.

There is one method which would be unexceptionable if it were only practicable, and that is to classify them according to their action on the body. Of this method a sketch containing a few substances will be found on p. 308, *ante*. If an attempt were made to complete the list by adding to it even all the well-recognised poisons, nothing but confusion would result, for so many of them act in more than one direction, and not only so, but now in one direction and now in another, *i.e.*, now on the heart, now on the brain, and now on the blood. We can go a little farther than Dr. Taylor did in this method of arrangement, for he divided them only into corrosives, irritants, and neurotics; but it is impossible to draw up a complete scheme.

If science fails us, the only principle left is convenience, and here we do get some little assistance in grouping certain poisons for descriptive and other purposes. The following groups have considerable convenience to recommend them, and there is also some appearance of a scientific connection between the members of each group, if not between the groups themselves:—

1. Corrosives, strong acids, and alkalies.
2. Poisons derived from metals and their salts.
3. ,, ,, the non-metallic elements.
4. Gaseous poisons.
5. Poisoning by anæsthetising agents, sedatives, and antipyretics of artificial origin.
6. Poisoning by artificial organic articles not in group 5.
7. Poisoning by substances of direct origin from the living vegetable kingdom.
8. Poisoning by substances of animal origin.
9. Poisoning by foodstuffs.
10. Miscellaneous poisons—mechanical, such as glass, coffin dust patent medicines, etc.

We shall insert a short explanation and discussion as an introduction to each group.

GROUP 1.—THE CORROSIVE POISONS.

Of this class the typical members are the concentrated mineral acids and caustic alkalies, and so long as these only are considered the group is a very natural one, but there are many objections to considering it a scientific one all the same. For instance, even nitric and hydrochloric acids may by their volatility act as simple pulmonary irritants to the bronchial tubes, while by dilution even sulphuric acid may act as an irritant only. Again, oxalic and carbolic acids should at times be included in the group, for they frequently kill by purely local action, but, on the other hand, they often do not corrode at all, but kill by their poisonous effects after absorption. Arsenic, again, not unfrequently produces small superficial ulcers, and so do some of the metallic irritants. The group, then, must be considered to consist typically of the strong mineral acids and alkalies and to shade off through the more dilute and less powerful acids down to the irritants.

Instances of poisoning by the following will be found described below:—

Concentrated sulphuric acid, indigo sulphate.
,, nitric acid and its fumes.
,, hydrochloric acid.
Hydrofluoric acid.
Pyrogallic acid.
Oxalic acid, oxalates (these are nerve poisons, not corrosives).
Carbolic acid (corrosive action comparatively feeble).
Caustic potash and soda and their carbonates (corrosive only when concentrated).
Ammonia and its carbonate.

The main principle connecting the several members of the class is that they *may* cause death by purely local destructive action, combined with shock and collapse produced by intense stimulation of sensory nerves. As shock and collapse are thus such marked features of the group, we may tabulate the symptoms of these phenomena as an introduction to the class.

SYMPTOMS OF SHOCK.

Alimentary Symptoms.—Most likely a feeling of nausea with inclination to drink because the mouth feels dry and clammy, quite possibly colic, and there may even be acute diarrhœa and temporary incontinence of fæces; actual vomiting is a very common symptom of recovery from shock.

Respiratory Symptoms.—Accelerated and gaspy breathing is common enough; actual dyspnœa or shortness of breath may come on; or if shock be deeper there may be merely sighing respiration.

Circulatory.—The pulse is almost sure to be accelerated in frequency and weakened in force; sometimes it is inappreciable and uncountable at the wrist; fainting—an actual temporary stoppage of the heart, or at least such a disturbance of the circulation through the brain that its functions fail temporarily—is also very common; even death may thus appear.

Urinary.—A sudden desire to micturate may occur, as may also unconscious passage of urine. *Per contra* when shock is severe there may be retention of urine even to the extent of necessitating catheterisation; milder degrees of actual suppression may also occur.

Nervous—*Motor:* Temporary paralysis of voluntary muscular power is not uncommon, trembling is pretty constantly present ("I felt all of a tremble"), and there may be even violent convulsions.

Sensory: Temporary anæsthesia is quite possibly present.

Reflexes: Diminished or even lost.

Bladder and Rectum: Control may be entirely lost (*vide* above).

Mental Condition: This is most variable, from actual profound unconsciousness and even death (frightened to death) up to the most definite active delirium with delusions of all kinds, every conceivable variety of excitement or of lethargy; the articulation may be incoherent or rapid or abolished, the mind stunned or accelerated in its working.

Skin.—Possibly bedewed with a cold clammy or a hot sweat.

The whole of these point unmistakably to a powerful reflex stimulus of every centre of the brain, with a corresponding excitement or paralysis of each one. Not only so, but the temporary excitement may be followed by a paralysis of any or every centre.

Symptoms of Collapse.

Collapse, so far as the brain and nerve centres are concerned, may be spoken of as the paralytic aspect of shock; the mind refuses to think or to be materially influenced by ordinary external stimuli; reflexes are either sluggish or absent; the limbs refuse to support the body; the condition is one of mental and physical annihilation. Along with these negatives we get other functions reduced to their lowest ebb, digestion, vomiting, and peristalsis cease, and respiration only suffices for the mere need of existence, not always even that, and the circulation is reduced to a minimum; urine ceases to be secreted by the kidney, and other glands refuse their functions. Such are the features of collapse generally, but when it has been preceded by severe vomiting the eyes are sunken, the features pinched, the skin and extremities cold and clammy, and possibly bedewed with cold perspiration.

POISONING BY SULPHURIC ACID (H_2SO_4).

Source and Method of Occurrence.—Sulphuric acid, or oil of vitriol, is more extensively used in the arts and manufactures than any other acid; hence cases of poisoning by it are very common. Occasionally it is used for suicidal purposes, more especially by women; and accidents in consequence of its having been mistaken for some other liquid are numerous. It has often been used externally (vitriol-throwing, *vide* Vol. I.), where the object was to injure a person, in fits of rage or jealousy. In the year 1891 thirteen deaths were registered from sulphuric acid in England and Wales, and eight in 1901.

Toxicity and Fatal Dose.—The effects of this acid, as of all corrosives and some irritants, depend not only upon the actual dose, but upon its concentration. The quantity actually required to prove fatal must depend on many circumstances. If the stomach is full when the poison is swallowed, the action of the acid may be spent on the food, and not on the stomach; and a larger quantity might then be taken than would suffice to destroy life if the organ were empty.

Attempts have been made in recent years to study, by means of the X rays and a screen, the position assumed in the stomach of the articles swallowed in the course of a meal. There is some evidence pointing to the idea that the articles last swallowed assume a central position with regard to those previously swallowed (like the rings of growth in a tree, only in inverse order). Though this view cannot be accepted in a strict sense it does at any rate offer some suggestive explanation of a reason for delay in the action of poisons swallowed after a meal.

The smallest quantity which is described as having proved fatal was in the following case:—

> Half a teaspoonful of concentrated sulphuric acid was given to a child about a year old by mistake for castor oil. The usual symptoms came on, with great disturbance of breathing, and the child died in twenty-four hours.

The quantity here taken could not have exceeded **forty drops** (*Med. Gaz.*, vol. 29, p. 147). It is, however, doubtful whether this small quantity would have proved fatal to an adult. The smallest fatal dose which Christison states he has found recorded is *one drachm;* it was taken by mistake by a stout young man, and killed him in seven days. Even when moderately diluted it will rapidly destroy life.

> A man swallowed, on an empty stomach, six drachms of the strongest acid diluted with eighteen drachms of water. He suffered from the usual symptoms, and died in two hours and a half (*Med. Times and Gaz.*, 1863, 1, p. 183).

Two-thirds of the cases prove fatal. The pharmacopœial dose is five to twenty minims of the dilute acid, of which 100 parts by weight contain 13·65 parts of pure acid.

Duration.—When this poison is swallowed in a concentrated form, the symptoms produced come on either *immediately*, or during the act of swallowing. In a case which came under the notice of Sir Thomas Stevenson, a girl swallowed about a fluid ounce of brown oil of vitriol in mistake for a magnesian mixture which she was in the habit of taking, and did not discover the mistake till severe symptoms had supervened. The average period at which death takes place in cases of acute poisoning by sulphuric acid is from **eighteen to twenty-four hours**. When the stomach is perforated by the acid it commonly proves more speedily fatal. In one instance, reported by Sinclair, a child about four years old died in four hours; the stomach was found perforated. When the poison acts upon the windpipe, death may be a still more speedy consequence, from suffocation; and, owing to this, it appears to be more rapidly fatal to children than adults. Craigie mentioned a case in which three ounces of concentrated sulphuric acid destroyed life in three hours and a half. Remer met with an instance in which death took place in *two hours*. A case is reported by Watson in which a woman swallowed two ounces of a strong acid. She died in *half an hour*, but it appears that a quarter of an hour before death she had made a deep wound in her throat, which gave rise to great bleeding. The stomach was found extensively perforated; but it is highly probable that the wound accelerated death in this case. The shortest case recorded occurred to Rapp. A man, æt. 50, swallowed three ounces and a half of concentrated sulphuric acid. He died in **three-quarters of an hour** (*Gaz. Méd.*, Dec. 28th, 1850). On the other hand, there are numerous instances reported in which the poison proved fatal from secondary causes at periods varying from one week to several months. These secondary causes, such as contraction and occlusion of the gullet, may threaten, and even cause, death from starvation, and require operative procedures. When the passage of bougies to dilate the stricture of the œsophagus has failed to procure relief, gastrotomy has been successfully performed, and the patient fed through an artificial opening into the stomach.

Symptoms.—There is violent burning pain, extending down the throat and gullet to the stomach, and the pain is often so severe that the body is bent. There is an escape of gaseous and frothy matter, followed by retching and vomiting, the latter accompanied by the discharge of shreds of tough mucus and of a liquid of a dark coffee-ground colour, mixed with blood. The vomited matters may contain shreds of mucous membrane from the gullet and stomach, and even portions of the muscular structures of the former. These may form complete casts of some portion of the gullet or stomach. The mouth is excoriated, and the lining membrane and surface of the tongue white, or resembling soaked parchment; in one instance the appearance of the mouth was as if it had been smeared with white paint. After a time the membrane acquires a grey or brownish colour; the mouth is filled with a thick viscid substance, consisting of saliva, mucus, and the corroded membrane; this renders speaking and swallowing difficult, and may cause death by asphyxia, especially if the epiglottis also becomes swollen. If the poison has been administered by a spoon, or the phial containing it has been passed to the back of the throat, the mouth may escape the chemical action of the acid. A medical witness must bear this circumstance in mind when he is required to examine an infant suspected to have been poisoned by sulphuric acid. Around the lips and on the neck may be found spots of a brown colour from the spilling of the acid and its action on the skin. There is great difficulty of breathing, owing to the swelling and excoriation of the throat and larynx, and the countenance has, from this cause, a bluish or livid appearance; the least motion of the abdominal muscles is attended with increase of pain. These symptoms, although characteristic of the action of a corrosive liquid, have been sometimes by carelessness mistaken for those of disease. The stomach is so irritable that whatever is swallowed is immediately ejected, and the vomiting is commonly violent and incessant. In a case reported by Geoghegan, the patient vomited for three or four hours. This symptom then ceased, and did not recur, although the woman did not die until thirty-four hours after the poison had been swallowed (*Med. Gaz.*, vol. 48, p. 328). The matters *first* vomited generally contain the poison; they are acid, and if they fall on a limestone pavement there may be effervescence if on coloured articles of dress, the colour is sometimes altered to red or yellow, or it is entirely discharged, and the texture of the stuff destroyed;

on a black cloth dress the spots produced by the concentrated acid are reddish brown, and remain moist for a considerable time. Attention to these circumstances may often lead to a suspicion of the real cause of the symptoms when the facts are concealed. After a time there is exhaustion, accompanied by great weakness; the pulse is quick, small, and feeble, the skin cold, mottled or dusky, and covered with a clammy sweat. There is generally great thirst, with obstinate constipation, and should any evacuations take place they are commonly either of a dark brown or leaden colour, in some instances almost black, arising from an admixture of altered blood. There are sometimes convulsive movements of the muscles, especially those of the face and lips. The countenance, if not livid from obstructed respiration, is pale, expressive of great anxiety and intense suffering. The intellectual faculties are quite clear, and in the greater number of cases of acute poisoning by this acid death takes place very suddenly in from eighteen to twenty-four hours after the poison has been taken:—

Walker met with a case in which a man, æt. 30, swallowed fifteen drachms and a half of sulphuric acid (sp. gr. 1·842), and died twenty-five hours afterwards. Half an hour after taking the poison he resembled a patient in the collapsed stage of cholera. The inside of the lips, as well as the tongue and throat, were swollen, and had the appearance of being smeared with thin arrowroot. He suffered severe pain, but did not vomit until *three-quarters of an hour* had elapsed; the vomiting appeared to be then excited by the liquid which had been given to him. The vomited matters were dark, bloody, and viscid. The patient was sensible up to the time of his death.

This case is remarkable in the fact that vomiting was not immediate; that there were no spots on the face; that the poison was swallowed in large quantity on an empty stomach; and there was free voluntary exertion, as twenty hours after he had taken the poison the man got out of bed and sat on a night-stool.

Treatment.—Treatment in theory is much simpler than in practice, owing to the intense pain caused by swallowing. We must aim at speedy neutralisation of the acid; the obvious and probably the handiest object for this purpose is bicarbonate of soda, and it must be used if nothing else is handy, but it, like any other carbonate, such as chalk, has the obvious disadvantage that the carbonic acid liberated may tear a damaged stomach. However, something must be rapidly done, and these carbonates must be used if handy. Whitening used to clean silver may be easy to get, perhaps, and should be used. Calcined magnesia is the best antidote; limewater may possibly be obtainable. Plaster from the ceiling may be used, or whitewash from a wall, egg-shells finely powdered. White of egg, soap and water, may be useful because easily obtainable. If none of these can be obtained, plain water must be given in considerable quantities. It will dilute the acid, and also render the vomiting less distressing. Milk or gruel will serve the same purpose, or oatmeal stirred up in simple water.

On no account must attempts be made to use the stomach-pump, and emetics are assuredly not required.

To relieve the pain morphia is sure to be essential, but if not handy any other anodyne may be used.

After the first effects are over, demulcent drinks will assist, but this need not be further discussed. The case is then one of acute gastritis, to be treated on ordinary principles. The burns of the skin, if present, must be treated also on ordinary principles after all acid has been wiped or washed away or neutralised.

The later troubles of gastric ulcer, stricture, etc., cannot be discussed here.

Post-mortem Appearances.—The marked effects of this poison are not always observed in the stomach; and they may be confined to the region of the throat and windpipe. In an inspection of the body the whole course of the alimentary canal from the mouth downwards should be examined, since in recent or acute cases it is in the throat and gullet that we generally obtain strong evidence of the action of a corrosive poison. The discovery of the usual marks of corrosion in these parts is always highly corroborative of the signs of poisoning found in the stomach. During the inspection the examiner must not omit to notice any spots on the skin produced by the spilling of the acid; these are commonly of a dark brown colour, and are situated about the mouth, lips, and neck. The appearances met with in the body vary according as death has taken place quickly or slowly. Supposing the case to have proved rapidly fatal, the membrane lining the mouth may be found white, softened, and corroded. The mucous membrane of the throat and gullet is commonly found corroded, having a brown-black or ash-grey colour, and dark-coloured blood is effused in patches beneath it. The corroded membrane of the gullet is occasionally disposed in longitudinal folds, portions of it being partly detached. The stomach, if not perforated, is collapsed and contracted. On laying it open the contents are commonly found of a dark brown or black colour and of a tarry consistency, being formed in great part of mucus and altered blood. The contents may or may not be acid according to the time the patient has survived and the treatment which has been adopted. On removing them the stomach may be seen traversed by black lines, or the whole of the mucous membrane may be corrugated, and stained black or of a dark brown colour. This blackness is not entirely removed by washing. On stretching the stomach traces of inflammation may be found between the folds, indicated by a dark crimson colour. On forcibly removing the blackened membrane the red colour indicative of inflammation may be seen in the parts beneath. Both the dark colour and marks of inflammation are sometimes partial, being confined to isolated portions or patches of the mucous membrane. When the stomach is perforated, the coats are softened, and the edge of the aperture is commonly black and irregular. In removing the stomach the opening is liable to be made larger by the mere weight of the organ. The contents do not always escape; but when this happens the surrounding parts are attacked by the poison. The spleen, the liver, and the coats of the aorta, have been found blackened and corroded by the acid, which had escaped through the perforation. In rare cases the lining membrane of the aorta has been found strongly reddened. When a person has survived for eighteen or twenty hours, traces of corrosive and inflammatory action may be found in the small intestines. In one case the mucous membrane of the ileum was corroded. The interior of the windpipe, as well as of the bronchial tubes, has also presented marks of the local action of the acid. The acid has thus destroyed life without reaching the stomach. A remarkable instance in which the poison penetrated into and destroyed both lungs has been reported by Gull (*Med. Gaz.*, vol. 45, p. 1102). It is important for a medical witness to bear in mind that the mouth, throat, and gullet are not always found in the state above described. Ogle met with a case in which the membrane of the tongue was but slightly affected. The man had swallowed a large dose of the acid and had died in nine hours (*Med. Times and Gaz.*, 1860, 1, p. 408). Strange as it may appear, cases are recorded in which, notwithstanding the introduction of this poison into the stomach, the gullet has escaped its chemical action.

Dickinson has reported a case of poisoning by sulphuric acid in which there was no corrosion of the mouth and throat. The patient, a female, æt. 52, recovered in about five months. The stomach had probably sustained injury, as the most urgent symptoms were constant vomiting after taking food and obstinate constipation. The quantity of acid swallowed was half an ounce, mixed with half an ounce of water. The patient felt *immediately* a burning sensation at the pit of the stomach (*Lancet*, 1853, 2, p. 502).

The acid had here evidently lost its corrosive power by dilution. Cases of recovery are rare.

A woman took into her mouth a quantity of the acid by mistake; she spat it out immediately. Magnesia was given to her, and two hours afterwards she was suffering from intense burning pain in the throat, gullet, and stomach. Her lips were swollen and blistered; the lining of the mouth was whitish, but not excoriated; the soft palate and uvula were congested and partly destroyed. Olive oil and bicarbonate of sodium were given at intervals. At a later period there was vomiting of an opaque, milky-looking substance. Two days after there was some difficulty of breathing, but this symptom subsided, and the patient was discharged apparently well (*Lancet*, 1871, 2, p. 540).

When the acid has been taken in a still more *diluted* state, the marks of inflammation on the mucous membrane are less decided, and the blackening is not so considerable. Nevertheless, the acid, unless too much diluted, acts upon and darkens the blood in the vessels, as well as that contained in the stomach, although it may not blacken the mucous membrane or the contents.

It is very common to find that the pyloric end of the stomach suffers more than any other part, and this is especially true in the chronic cases, that is, in those cases which die months or even years after the original trouble.

Analysis.—This acid may be met with either concentrated or diluted; and a medical jurist may have to examine it under three conditions: (1) in its simple state; (2) when mixed with organic matters, as with liquid articles of food, or in the contents of the stomach; (3) on solid organic substances, as where the acid has been thrown or spilt on articles of dress or clothing.

In the Simple State.—If *concentrated*, it possesses these properties: (1) Wood, sugar, or other organic matter plunged into it, is speedily carbonised or charred, either with or without the application of heat. (2) When boiled with wood, copper cuttings, or mercury, it evolves fumes of sulphurous acid; this is immediately known by the odour, as well as by the acid vapour first rendering blue, and then bleaching, starch-paper dipped in a solution of iodic acid. (3) When mixed with an equal bulk of water, great heat is evolved.

The Diluted Acid.—For the acid in a diluted state but one test need be applied, either the *nitrate of barium* or the *chloride of barium*. Having ascertained by test-paper that the liquid is strongly acid, we dilute a portion of it, and add a few drops of nitric acid, and then a solution of the barium salt. If sulphuric acid is present, a dense white precipitate of sulphate of barium will fall down; this is insoluble in all acids and alkalies. The precipitate is collected, washed, dried, and mixed with five parts of charcoal in powder. This mixture is placed in a small platinum crucible, which should be closely covered, and then heated to full redness for five minutes. If the precipitate is a sulphate, it will thus be converted into a sulphide. In order to prove this, (1) a portion of the mixture when cooled may be mixed with water, well stirred, and filtered. A pale, yellowish liquid will be obtained, having an alkaline reaction, and giving a brown or black precipitate with a solution of acetate of lead. (2) If in small quantity, the mixture may be placed at once on glazed card (coated with hydrocarbonate of lead) and wetted, when a stain of sulphide of lead will be produced. (3) The powder may be heated with strong hydrochloric acid, when sulphuretted hydrogen will be copiously evolved, known by its smell and other properties. If the quantity of precipitated sulphate is very small, it may be mixed with one-third of its weight of cyanide of potassium and heated in a reduction tube to full redness. The residue, placed on glazed card and wetted, gives the reaction indicative of the presence of a sulphide, proving that the original precipitate was a sulphate, and that sulphuric acid was present in the liquid submitted to analysis.

Dilute sulphuric acid does not carbonise organic substances which are immersed in it. The application of heat will only effect carbonisation when the water of the acid is in great part evaporated. Thus paper or linen, wetted with the dilute acid, becomes charred when dried and heated. This may serve as one method of identification in the absence of tests.

In Liquids containing Organic Matter.—If sulphuric acid is mixed with such liquids as porter, coffee, or tea, the liquid is first rendered clear by filtration. Some liquids, such as vinegar, beer, and most wines, generally contain a soluble sulphate and have an acid reaction. Should the liquid be thick and viscid like gruel, it may be diluted with water, and then boiled with the addition of a little acetic acid. For the action of the barium test it is not necessary that the liquid should be absolutely clear, provided it is not so thick as to interfere mechanically with the subsidence of the precipitate. So far with regard to liquids administered, or of which the administration has been attempted. A similar process may be applied to the examination of matters *vomited* and of the *contents of the stomach*, care being taken to separate the insoluble parts by filtration, before adding the test. The coats of the stomach should be cut up and boiled in distilled water for some time for the perfect extraction of the acid. The decoction filtered and concentrated by evaporation may then yield evidence of its presence, and is tested for the presence of a free mineral acid in one of two ways. Ferric acetate is mixed with a solution of sulpho-cyanide of potassium. This mixture will yield a blood-red colour when added to the suspected liquid should a free mineral acid be present. An alcoholic solution of methyl-violet is also rendered blue when one four-thousandth part of sulphuric acid is added. If there be evidence of a free mineral acid, and the liquid yield a decided precipitate with solution of nitrate of barium, it should be concentrated by evaporation if necessary, and strong alcohol be added till the mass contains 75 per cent. by volume of absolute alcohol. The soluble sulphates are thus precipitated; and, after standing and filtration to remove these, the filtrate is neutralised with solution of potash, the alcohol distilled off, the solution evaporated to dryness. The residue, when taken up with water, may then be tested with nitrate of barium after acidification with hydrochloric acid. One part of the precipitate corresponds to 0·42 part by weight of sulphuric acid.

When the acid is mixed with milk, decomposed blood, and mucus, or other substances which render it thick and viscid, it may be readily separated by **dialysis**, a process which is applicable to the other acid poisons, such as the nitric, hydrochloric, and oxalic. A portion of the acid viscid liquid should be placed in a test tube, about five inches long and one inch in diameter, open at both ends, the neck being securely covered with a layer of thin bladder or parchment paper. The tube is then immersed, mouth downwards, in a vessel containing distilled water. After some hours the acid will pass through the membrane, and may be detected in the water. This process may be employed as a trial test of the contents of the stomach when they have a strongly acid reaction. In thus testing for sulphuric acid it must be remembered that a sulphate, such as Epsom salts, may be present in the liquid, and an innocent acid like vinegar or lemon-juice may give the acid reaction. To remove any fallacy on this ground, a portion of the liquid tested should be evaporated, and treated with alcohol as already described.

It is an important fact that the contents of a stomach in a case of poisoning by sulphuric acid are sometimes entirely free from any traces of this poison, even when it has been swallowed in large quantity. The acid is not commonly found when the person has been under treatment, when there has been considerable vomiting, aided by the drinking of water or other simple liquids, or when he has survived several days. If the case has been under treatment, the acid is either wholly absent or neutralised by antidotes.

A girl swallowed four or five ounces of diluted oil of vitriol, and died in eighteen hours. No portion of the acid could be detected in the stomach; but she had vomited considerably, and the acid was easily proved to exist in the vomited matters by examining a portion of the sheet of a bed which had become wetted by them. In another case, nearly two ounces of the concentrated acid were swallowed; the patient died in twenty-five hours; the stomach was extensively acted on, and yet no trace of the acid could be discovered in the contents.

The liquidity of the poison, and the facility with which it becomes mixed with other liquids and ejected by vomiting, will readily furnish an explanation of this fact. In many cases of poisoning by sulphuric acid, therefore, a medical witness must be prepared to find that chemical analysis will furnish only negative results. This, however, is not inconsistent with death having taken place from the poison. Casper has dealt with this question. He relates three cases of poisoning by sulphuric acid which occurred in his practice, one which proved fatal in eight days, a second in five days, and a third in three days. In not one instance could a trace of the poison be found ("Handb. der Ger. Med.," 1, pp. 421, 429) (*vide*, p. 329, *ante*). If the stomach should be perforated, the contents will be found in the abdomen, or perhaps in the lower part of the cavity of the pelvis. They may then be collected, boiled with distilled water, and the solution examined for the acid by the process already described. If the contents of the stomach are highly putrefied, the sulphuric acid may be found combined with ammonia.

On Solid Organic Substances.—It sometimes happens in cases of poisoning by sulphuric acid that it is spilled upon articles of clothing, such as cloth or linen, and here a medical jurist may succeed in detecting it when every other source of chemical evidence fails. Again, sulphuric acid is often used for the purpose of seriously injuring a party, as by throwing it on the person (*vide* Vol. I., under "Vitriol Throwing"). The process of analysis is simple. The spot, unless it has been washed, strongly reddens litmus paper pressed upon it. The stained fabric should be digested in rectified spirit at a gentle heat, whereby a brownish-coloured liquid may be obtained on filtration. If sulphuric acid is present, the liquid will have an acid reaction, and produce the usual effects with the barium test after evaporation and dilution with water. Old stains are known by the complete destruction of the organic fibre, fresh stains by their dampness. The acid remains fixed in the stuff. Sulphuric acid has been thus detected in clothing after the lapse of twenty-seven years. The detection of spots of this acid on articles of dress has in some cases served to supply the place of direct evidence from a chemical analysis of the stomach; and in other instances it has aided justice in fixing on an accused person the act of administration.

Cases.—The importance of analysis applied to articles of clothing was made evident in *R.* v. *Brown* (Bury St. Edmunds Lent Ass., 1864). The deceased, aged three years, was an illegitimate child of the prisoner. It was living with the prisoner's father and mother. On the day of its death the prisoner came to see the child, and was with it alone in a bedroom. In *five minutes* after she had left the room, no other person being present, the child was heard to be sick, and it was found to be suffering from the effects of some corrosive acid. The child died in nine or ten hours, and the symptoms during life, when it was seen by a medical man, as well as the appearances in the body after death, were clearly those of poisoning by oil of vitriol. The acid was detected in vomited matter on the shirt of the child, and on a dress worn by the mother on the occasion of her visit. It was further proved that a bottle of vitriol, kept in a closet of the house where she was a servant, was missing. In spite of these strong facts in proof of administration, the jury, under the charge of Cockburn, C.J., acquitted the prisoner. It was somewhat remarkable that the child did not scream from pain during the act of swallowing, and that attention should not have been called to its conditition until after the lapse of five minutes. Still the facts appeared to point to the prisoner only as the person who administered the poison.

SULPHATE OF INDIGO.

Source and Method of Occurrence.—The compound is a commercial product, and consists essentially of a solution of indigo in strong sulphuric acid. Several cases of accidental poisoning by it have occurred.

As indigo is one of the substances now directed to be mixed with arsenic when this poison is sold in small quantities, the detection of this colouring principle in the mouth and vomited matters will not necessarily show that it has been taken in the form of sulphate.

Toxicity and Fatal Dose; Duration; Symptoms; Treatment.—These are similar to those which have been already described for sulphuric acid, which is the toxic agent. This kind of poisoning may be suspected when, together with these symptoms, the membrane of the mouth has a blue or blue-black colour. The vomited matters, as well as the fæces, are at first of a deep blue-black tint, afterwards green; and it was observed in two instances that the urine voided by the patients had a blue tinge.

Analysis.—The solution is of a dark blue colour, and strongly acid. Sulphuric acid is detected in it by the methods above described. The blue colour is discharged by chlorine, or when a portion previously diluted is boiled with nitric acid.

POISONING BY NITRIC ACID (HNO_3).

Source and Method of Occurrence.—Nitric acid is popularly known under the name of aquafortis, or red spirit of nitre. According to Tartra, it seems to have been first used as a poison about the middle of the fifteenth century. Although it is perhaps as much used in the arts as oil of vitriol, cases of poisoning by it are not very common. In the year 1901 seven deaths from this acid were recorded in England and Wales, of which two were accident, five suicide.

Toxicity and Fatal Dose.—These again depend more upon concentration than on actual quantity. The *smallest* quantity of this acid which we find reported to have destroyed life is about *two drachms.* It was in the case of a boy, aged thirteen; he died in about thirty-six hours. But less than this quantity, even one drachm, would doubtless suffice to kill a child, and under certain circumstances an adult, for the fatal result depends on the extent of the mischief produced by this corrosive poison in the windpipe, gullet, and stomach. What is the largest dose of concentrated acid from the effects of which a person has recovered it is difficult to say, since in most of the cases of recovery mentioned by authors the quantity of the poison taken was unknown. A case of recovery from about half an ounce of the strong acid mixed with the diluted acid is reported (*Lancet,* 1870, 1, p. 549). The patient was a man æt. 21. He had the usual symptoms, with the exception that there was no yellowing of the teeth, nor corrosion of the mouth. The vomited matters were bloody and of a dark colour. He suffered from stricture of the gullet, and this remained when he left the hospital about fifteen weeks after his admission. In Sir Thomas Stevenson's case (p. 383) of poisoning by three ounces of nitric acid, death resulted in seventeen hours. The stomach was perforated. The pharmacopœial dose is 5 to 20 minims of the dilute acid, 17·44 per cent. by weight.

Duration.—The symptoms of acute definite poisoning will come on practically instantaneously while swallowing the fluid if it be at all concentrated, but when the dilute acid is taken the time of occurrence of symptoms will depend largely on the condition of the stomach as regards contents, and not only so, but the severity of the symptoms too. Sobernheim relates a case of poisoning by nitric acid which proved fatal in **one hour and three quarters** (*op. cit.* 402). This the editor believes to be the most rapidly fatal instance on record in an adult. The usual well-marked effects were found in the gullet, stomach, and small intestines. In infants, however, life may be destroyed by this poison in a few minutes should it happen to affect the larynx. The longest case is, perhaps, that recorded by Tartra, where a woman perished from exhaustion, produced by the secondary effects of the poison, *eight months* after having swallowed it, but there is no reason why this should remain a record in the face of modern surgery. Death commonly takes place in from eighteen to twenty-four hours, and is sometimes preceded by a kind of stupor, from which the patient is easily roused. The intellectual faculties commonly remain clear until the last. In one instance the patient was insensible, but she ultimately recovered.

Symptoms.—When nitric acid is taken in a concentrated state, the symptoms, on the whole, bear a close resemblance to those produced by sulphuric acid. They come on *immediately*, and the swallowing of the acid is accompanied by intense burning pain in the throat and gullet extending downwards to the stomach. There are gaseous eructations from the chemical action of the poison, swelling of the abdomen, violent vomiting of liquid or solid matters, mixed with altered blood of a dark brown colour, and shreds of yellowish-coloured mucus, having a strongly acid reaction. The abdomen is generally exquisitely tender, but in one well-marked case of poisoning by the acid the pain was chiefly confined to the throat: probably the poison had not reached the stomach. The mucous membrane of the mouth is commonly soft and white, after a time becoming yellow, or even brown; the teeth are also white, and the enamel is partially destroyed by the chemical action of the acid. There is great difficulty in speaking and swallowing, the mouth being filled with viscid mucus; the power of swallowing is, indeed, sometimes entirely lost. On opening the mouth the tongue may be found swollen, and of a citron colour; the tonsils are also swollen and enlarged. The difficulty of breathing is occasionally such as to render tracheotomy necessary, especially in young persons. As the symptoms progress the pulse becomes small, frequent, and irregular, the surface of the body cold, and there are frequent rigors (shivering). The administration of remedies, even the swallowing of the smallest quantity of liquid, increases the severity of the pain, occasions vomiting, and gives rise to a feeling of laceration or corrosion. There is obstinate constipation. Death may be occasioned by the action of this acid on the larynx, as in the case of sulphuric acid. Should the patient survive the first effects of the poison, the mucous membrane of the throat and gullet may be ejected, either in irregular masses, or in the form of a complete cylinder. There is great irritability of the stomach, with pain on taking food, frequent vomiting, and ultimate destruction of the powers of digestion; the patient becomes slowly emaciated, and dies, sometimes after many months, from starvation or exhaustion. A man swallowed nitric acid in beer. He recovered from the first symptoms, but died six months afterwards, evidently from the injury caused by the poison to the mucous lining of the stomach. He suffered from pain and from such irritability in this organ, that neither solids nor fluids could be retained (*Lancet*, 1860, 2, p. 510). For a similar case *vide* London Hospital P.M. Records, 1904.

There is one very important particular in which nitric and hydrochloric acids differ from sulphuric, viz., in their volatility, so that at the ordinary temperatures of the air they give off fumes which will cause serious and even fatal injury to the mucous membrane of the air-passages. In these cases the symptoms are those of intense suffocative bronchitis (*vide* cases). The fumes of nitrous acid vapour, which are generally associated with nitric acid, are of a very deadly kind. In the manufacture of gun-cotton acid vapours are evolved, which, if respired, although they may produce no immediate ill effects, are liable to cause bronchitis and death.

Treatment.—The same as for sulphuric acid.

Post-mortem Appearances.—Supposing death to have taken place rapidly from the liquid acid, the following appearances may be observed. The skin of the mouth and lips will present various shades of colour, from an orange-yellow to a brown; it appears like the skin after a blister or burn, and is easily detached from the subjacent parts. Yellow spots produced by the spilling of the acid may be found about the hands and neck. A yellow frothy liquid escapes from the nose and mouth; and the abdomen is often much distended. The membrane lining the mouth is sometimes white, at others of a citron colour; the teeth are white, but present a yellowish colour about the coronæ. The pharynx and larynx are much inflamed; and the latter is sometimes œdematous. The lining membrane of the gullet is softened, and of a yellow or brown colour, easily detached, often in long folds. The windpipe is more vascular than usual, and the lungs are congested. The most strongly marked changes are, however, seen in the stomach. When not perforated, this organ may be found distended with gas, its mucous membrane inflamed, and covered by patches of a yellow, brown, or green colour, or it may be even black. This green colour is due to the action of the acid on the colouring matter of the bile; but it must be remembered that a morbid state of the bile itself may give a similar appearance to the mucous membrane in many cases of death from natural disease. There is occasionally inflammation of the peritoneum, and the stomach is adherent to the surrounding organs. Its coats may be so much softened, as to break down under the slightest pressure. In the duodenum similar changes are found; but in some cases the small intestines have presented no other appearance than that of slight redness. It might be supposed that the stomach would be in general perforated by this corrosive liquid; but perforation has not been often observed. Tartra met with only two instances, and in one of these the person survived twenty, and in the other thirty hours. In giving this poison to rabbits he did not find the stomach perforated, although the acid had evidently reached that organ, as its coats were stained of a deep yellow colour. In these experiments the non-perforation appeared to be due to the protective influence of the food with which the stomach was distended. In the cases that are reported in English journals all the stomach has not been perforated, the poison has been swallowed soon after a meal, and its coat has thus escaped the corrosive action of the acid. In a case which proved fatal after the long period of six months, there was, at the intestinal end of the stomach, a distinct cicatrix with puckering and hardening of the surrounding mucous membrane, causing a slight contraction of the pyloric orifice. The only other appearance consisted in some dark longitudinal lines on the posterior surface of the lining membrane of the gullet. This had probably been caused by the acid (*Lancet*, 1860, 2, p. 510). In 1871 a man died in Guy's Hospital seventeen hours after swallowing three fluid ounces of commercial nitric acid. On examination the stomach was found much disorganised. There was a small aperture on the anterior surface, half an inch from the lower border and one inch to the left of a vertical line drawn from the entrance of the gullet. Around the opening the peritoneum was ecchymosed, but no lymph was exuded; and it is probable that the rupture had taken place about the time of death. The duodenum showed signs of sloughing on the valvulæ conniventes; whilst the jejunum and ileum were natural in appearance (Guy's Hosp. Rep., 1872, p. 223).

Analysis.—*In the simple state.* This acid may be met with either concentrated or dilute. The *concentrated acid* varies in colour from a deep orange red to a light straw yellow. It may be recognised, 1. By evolving acid fumes when exposed to the air or when heated. 2. By its staining nitrogenous organic matter, such as wool, yellow or brown, the colour being heightened and turned to an orange-red tint by contact with caustic alkalies. 3. When mixed with a few copper cuttings, it is rapidly decomposed, deep red acid vapours are given off, and a bluish-green solution of nitrate of copper is formed. Tin or mercury may be substituted for copper in this experiment. 4. On the addition of gold-leaf and a few drops of hydrochloric acid, and warming the mixture, if nitric acid is present the gold is dissolved. Common aquafortis (nitric acid) sometimes contains as impurity, a sufficiency of hydrochloric acid to dissolve gold-leaf. *In the dilute state.* This acid is not precipitated, like sulphuric, by any common reagent, since all its basic combinations are soluble in water. 1. The liquid has a highly acid reaction, and on boiling it with some copper turnings, red nitrous fumes are given off, unless the proportion of water is very great. At the same time the liquid acquires a blue colour. 2. A streak made on white paper with the diluted acid does not carbonise the paper when heated; but a faint yellow stain is left. 3. The liquid is not precipitated by salts of barium or of silver. The two last experiments give merely negative results: they serve to show that sulphuric and hydrochloric acids are absent.

In order to detect nitric acid, the liquid should be first tested for the presence of a free mineral acid in the way described for sulphuric acid; then carefully neutralised by a solution of potash, and evaporated slowly to obtain crystals. If the liquid contain nitric acid, these crystals will possess the following characters:—1. They appear in the form of lengthened fluted prisms, which neither effloresce nor deliquesce on exposure. One drop of the solution, evaporated spontaneously on glass, will suffice to yield distinct and well-formed prismatic crystals. This character distinguishes nitrate of potassium from a large number of salts. 2. When moistened with strong sulphuric acid, the powdered crystals slowly evolve a colourless acid vapour. By this test the nitrate is known from every other deflagrating salt. 3. A portion of the powdered crystals should be placed in a small tube and mixed with their bulk of fine copper filings. The mass is then to be moistened with water, and a few drops of strong sulphuric acid added. Either with or without the application of a gentle heat, orange-red nitrous fumes are evolved, recognisable by their colour, odour, and reaction, and by their setting free iodine on starch-paper moistened with a solution of iodide of potassium. A small crystal of green ferrous sulphate may be substituted for the copper. This acquires a pink or black colour, and on warming the mixture orange-red fumes escape. The suspected nitrate should be free from any alkaline chloride, and only a small reduction tube should be used when the quantity of the nitrate is small. If the nitrate is mixed with chloride, the following process will be found preferable. 4. Add to the powdered crystals a small portion of gold-leaf and strong hydrochloric acid; then boil for a few minutes. The gold will either partially or entirely disappear if nitric acid or a nitrate is present. Its partial solution will be indicated by a dark brown or purple colour on the addition of stannous chloride to the liquid after boiling.

In liquids containing organic matter.—Nitric acid may be administered in such liquids as tea, vinegar, or beer. In this case, besides the acid reaction, there will be a peculiar smell produced by the strong acid, when mixed with substances of an organic nature. The application of the usual tests may be here counteracted: thus, unless the quantity of nitric acid in the liquid is rather large, the orange-red nitrous fumes are not evolved on boiling it with copper cuttings. The action on gold-leaf will enable the chemist to detect nitric acid in coffee, tea, and similar organic liquids, even when the proportion of acid is small. Boil a fragment of gold-leaf in pure hydrochloric acid, and add while boiling a few drops of the suspected organic liquid to the mixture. If the acid is present the gold will be dissolved. When the acid liquid is thick and turbid, a portion of it may be placed in a tube and submitted to the process of dialysis. Vomited matters, as well as the contents and coats of the stomach (cut up), should be boiled in water, and filtered. If not cleared by filtration, they may be submitted to dialysis, and the acid water obtained neutralised by potash, and concentrated. If by filtration we succeed in procuring a clear acid liquid, the colour is of no importance. The liquid should be carefully neutralised with a solution of pure potash, and concentrated by evaporation. Drops of this may be placed on a slide, and the crystals microscopically examined and compared with those of nitre. Paper dipped into the concentrated neutralised liquid, and dried, burns with deflagration like touch-paper.

The crystals obtained by evaporating the neutralised liquid are generally coloured with organic matter, but they fuse into a white mass when heated in a platinum capsule. The pure nitre thus obtained may be tested as above described. The organic matter in the crystals does not interfere with the results of the copper and gold tests.

When either the nitric acid, or the nitrate into which it has been converted, is mixed with common salt, the copper test cannot be employed. The gold test will in such a case furnish the best evidence. Hydrochloric acid with a small portion of gold-leaf may be added to the dried residue, and the mixture boiled. If nitric acid or a nitrate is present, even in minute proportion, some portion of the gold will be dissolved, a fact demonstrable by the addition of stannous chloride.

Nitric acid may be detected in *stains on clothing*, if recent, by simply boiling the stained cloth in water. An acid liquid will be obtained, unless the stains are of old date or the stuff has been washed. This liquid, when concentrated, may be dealt with in the manner already described. The stains from this acid on black and blue cloth are of a yellow or brownish-yellow colour. When long exposed they become dry, but the cloth is easily torn. A simple method of detecting the acid is to boil at once a piece of the stained cloth with a fragment of gold-leaf and hydrochloric acid. If nitric acid or a nitrate is present in the stain, a portion of the gold will be dissolved (see also p. 388).

The two following tests for the presence of a nitrate are so very delicate that they should be added, but it must be remembered that harmless nitrates are very possibly present in the suspected material, hence they are merely to be used as corroborative tests, and too much must not be made of positive results from them.

1. If to a nitrate a few drops of strong sulphuric acid are added and then a crystal of Brucine stirred into the mixture, a bright red colour is produced. This test is so delicate that even a considerable amount of foreign colouring material does not obscure it, though, of course, the less colour from other sources the better the blood-red colour of the Brucine reaction is seen.

2. If to a test tube containing a colourless solution of a nitrate a few crystals of ferrous sulphate be added and the test tube shaken for a moment or two and then some strong sulphuric acid be added in such a manner that the sulphuric acid fills the bottom of the test tube, then at the junction of the sulphuric acid and the liquid to be tested a dark-brown, almost black, ring will develop; moreover, around those crystals of the ferrous sulphate which have not completely dissolved a similar brown or black ring will develop. This test, though very delicate in colourless solutions, is useless in coloured ones.

Cases.—In 1854, Mr. Haywood, a chemist of Sheffield, lost his life under the following circumstances:—He was pouring a mixture of nitric and sulphuric acids from a carboy containing about sixty pounds, when by some accident the vessel was broken. For a few minutes he inhaled the fumes of the mixed acids, but it does not appear that any of the liquid fell over him. Three hours after the accident, he was sitting up and appeared to be in moderately good health. He was then seen by a medical man, and complained merely of some cuts about his hands. He coughed violently. In three hours more there was difficulty of breathing, with increase of the cough. There was a sense of tightness at the lower part of the throat, and the pulse was hard. At times he said he could scarcely breathe. He died eleven hours after the accident. On inspection, there was congestion of the windpipe and bronchial tubes, with effusion of blood in the latter. The heart was flaccid, and contained but little blood; and the lining membrane of the heart and aorta was inflamed. The blood had a slightly acid reaction.

A similar accident occurred to Mr. Stewart and one of the janitors of an educational institution in Edinburgh, in 1863. A jar of nitric acid, which he was carrying, fell on the floor and was broken. He and the janitor, instead of withdrawing from the spot, wiped the floor, and attempted to save some of the acid. They thus inhaled the fumes which were immediately diffused. Stewart returned home unconscious of the mischief which had been done. After an hour or two, difficulty of breathing came on, and in spite of every effort to save his life, he died in ten hours after the accident. The janitor suffered from similar symptoms, and died the day following (*Chem. News*, 1863, p. 132).

On one occasion, in preparing gun-cotton, the author accidentally inhaled the vapour and suffered from severe constriction of the throat, tightness in the chest, and cough for more than a week. The fumes from batteries worked with nitric acid are often productive of serious results, and Sir Thos. Stevenson has met with serious cases resulting from their inhalation.

In 1888 a man was convicted of the murder of a woman by pouring nitric acid down her throat whilst in bed (*R.* v. *Lipski*, C. C. C., July, 1888). In reality a mixture of sulphuric and nitric acids, containing more sulphuric than nitric, was employed. Such a mixture does not char cellulose (wood and cotton) like sulphuric acid, but converts it into nitro-cellulose, which substance was found by Sir Thos. Stevenson in the stains on the deceased woman's linen, and also in wood cut from the floor of the room in which the murder was committed.

The following cases and remarks are taken from the *Lancet*, 2, 1897, p. 226:—

On May 17th a serious fire, caused by the bursting of a carboy filled with nitric acid, broke out on the premises of the well-known chemical factory of Bayer and Co. in Elberfeld. The conflagration very soon involved the whole building where the stock of this chemical was kept, and a high wind drove the smoke and fumes towards the firemen, who were immediately seized with a violent cough, dyspnœa, nausea, and headache, rendering it necessary for them to be relieved every few minutes. Strange to say, the men who were thus attacked soon felt quite well again, so that they were able to continue on duty and to walk home when the fire was over, but after several hours thirteen of them developed symptoms of poisoning, the consequence being that eleven were taken to the hospital, whilst two died before they could be admitted. Dr. Künne, chief physician to the hospital, has described the cases in the last number of the *Deutsche Medicinische Wochenschrift*. The symptoms differed much in their intensity, but all the patients suffered from dyspnœa, vomiting, cyanosis of the skin, sopor, and clonic convulsions. The heart's action was at first accelerated, but within a few hours became very slow, making only from forty-five to fifty-four beats per minute; sometimes the pulse was irregular. All the patients, even those who did not cough very much, complained of oppression in the chest and great pain near the sternum. This was followed by severe bronchitis, the expectoration being sometimes of a yellow colour and sometimes tinged with blood. Some of the patients had a difficulty in swallowing, due to inflammation of the fauces. Of course they were unable to sleep, but only a few became feverish. Albumen was found in the urine of three of them for periods varying from three to eight days. Seven of the men recovered completely within ten days, but the remaining four were very weak and off duty for about a fortnight longer. It appears from these cases that nitric acid has a very injurious influence on the human body, and that the opinions to the contrary effect formerly held by some medical men were erroneous; the nature of the chemical substance which is formed when it is introduced into the blood is not yet known, but it obviously affects the vasomotor and respiratory organs, the kidneys, and the nervous system. Medical treatment is restricted to the alleviation of symptoms. Fires in chemical works are often extremely dangerous to firemen. An occurrence similar to that at the Elberfeld factory happened recently in Schering's chemical works in Berlin, when no less than three officers and sixty men of the fire brigade showed symptoms of poisoning, and were rendered unfit for duty; their cases, however, have not yet been described in the medical journals.

The two following also show the danger of the fumes from nitric acid:—

An inquiry was held at Aston on May 5th relative to the death of a man described as an annealer and dipper. His duty appears to have been that of dipping copper cups in dilute nitric acid after they had been annealed and pickled. The medical evidence pointed to acute congestion of the lungs, a condition consistent with the statement that the deceased had inhaled acid fumes. The jury returned a verdict in accordance with this and added that they did not attach any blame to anyone, but recommended the company to supply chemically charged respirators for the men employed in work similar to that which the deceased did and to have printed notices exhibited to that effect. The product of the action of dilute nitric acid on copper is, of course, nitric oxide, which, however, in contact with air forms nitric peroxide. This dark red fume meeting the moisture of the respiratory passages would split up into nitrous and nitric acids, which are distinctly injurious to the lung tissue (*Lancet*, 1, 1898, p. 1341).

On September 19th a man, 32 years of age, employed by Messrs. Curtis and Harvey in the manufacture of nitro-glycerine, was admitted into St. Bartholomew's Hospital, Rochester, and died an hour later. He was too distressed to give any account of what had caused his illness. On admission he was cyanosed, with laboured and shallow breathing. His pulse rate was 120, his respirations were 42, and his temperature was 98° F. He was put to bed surrounded with hot-water bottles, strychnine was given hypodermically, and oxygen was administered. On two occasions he coughed up a small amount of frothy blood-stained fluid. His heart continued to beat for a short while after respiration ceased. At the necropsy the pleural cavities were found to contain a good deal of fluid; the lungs were very congested and full of frothy fluid; the blood was very dark in colour and had not coagulated. Nitro-glycerine is made by treating glycerine with sulphuric and nitric acids. The waste acid left at the end of the process is said to contain 70 per cent. of H_2SO_4, 10 per cent. of HNO_3, and 20 per cent. of water. When all nitro-glycerine had been skimmed off the acid liquid was made to flow along an open drain through which water had been running. The man neglected to shut off the water beforehand, and when the acid liquid came in contact with the water it boiled over. He, to conceal his omission, wiped up the mess and inhaled fumes of nitric oxide and nitric peroxide, into which the nitric acid is said to be broken up by the heat. This, it was stated, happened at 8 a.m., and the man continued at work until 12 noon, when illness compelled him to stop. We are indebted to Dr. Daniel Cowin for the history of the case (*Lancet*, 2, 1902, p. 1163).

POISONING BY HYDROCHLORIC ACID (HCl).

Source and Method of Occurrence.—Popularly known as spirits of salt, hydrochloric acid is an important commercial commodity. It is commonly taken by accident, but suicides use it also. It was the cause of 12 fatal accidents in 1901, of no fewer than 50 suicides, but not once did it give rise to a charge of murder or manslaughter.

Toxicity and Fatal Dose.—Remarks similar to those made on nitric acid may be used of hydrochloric. The smallest quantity of hydrochloric acid which has as yet been known to prove fatal was a **teaspoonful** in a girl fifteen years of age. For other cases in which an ounce was taken and the persons recovered, see *Lancet*, 1850, 2, p. 113, and the *Med. Gaz.*, December 28th, 1849. Otto reported a fatal case in a child (Horn's *Vierteljahrsschr.*, 1865, Bd. 1, p. 361). The pharmacopœial dose is five to twenty minims of the dilute acid, strength 10·58 per cent. by weight.

Duration — Symptoms — Treatment.—These are similar to those of nitric acid, including the warning as to volatility.

Post-mortem Appearances.—These again resemble those of nitric acid, with this important (for exact diagnosis) exception, that hydrochloric never stains tissues yellow; they may be whitened, or, if the acid is in concentrated state, blackened. According to experience, too, it has less tendency than the other two strong mineral acids to perforate the stomach. (For a case showing pyloric stenosis of extreme degree, *vide* Lond. Hosp. P.M. Records for July 18th, 1904.)

Analysis.—In a *concentrated* state, hydrochloric acid evolves copious fumes. The pure acid is nearly colourless; the commercial acid is of a lemon-yellow colour, and frequently contains iron, arsenic, common salt, and other impurities. It reddens litmus paper strongly, and gives the general reactions of a mineral acid. When boiled with a small quantity of black oxide of manganese, chlorine is evolved. It does not dissolve gold-leaf until a few drops of nitric acid have been added to it, and the mixture is heated. In the *diluted* state, these properties are lost. It gives a dense white precipitate when a solution of nitrate of silver is added to it. This precipitate is insoluble in nitric acid, but soluble in ammonia; it acquires a purple and black colour if exposed to light, and when heated it melts without decomposition, forming a yellowish-coloured substance on cooling. If the acid is contained in organic liquids in moderate quantity, it admits of separation by distillation to dryness. In this case any fixed chlorides present are left in the retort. It may also be procured by dialysis in a state fit for testing.

Hydrochloric acid, in small quantity, as well as alkaline chlorides, are natural constituents of the fluids of the stomach and bowels. The presence of local chemical changes in the throat and stomach would show whether the acid had been taken as a poison. If the acid is found only in minute quantity, no inference of poisoning can be drawn unless there are distinct marks of its chemical action upon the throat and stomach. It darkens the blood like sulphuric acid, although it has not the same degree of carbonising action on organic matter. The *stains* produced by this acid on black cloth are generally of a slight reddish colour. As the acid is volatile, it may possibly disappear from the stuff. If recent, the acid may be separated by boiling the stuff in water and applying the silver test, or by boiling a portion of the stained cloth with gold-leaf and nitric acid. An unstained portion of cloth should be similarly tested for the sake of comparison, as neutral chlorides give a similar precipitate with nitrate of silver.

Case.—A trial took place at the Taunton Winter Assizes, 1866 (*R.* v. *Somers*), in which a girl of twelve years of age was charged with administering this acid to her mistress in beer, with intent to murder her. Some of the acid had been purchased for domestic use, and the prisoner had been cautioned not to touch it as it was poisonous. On tasting the beer prosecutrix perceived an unpleasant taste, and had a burning sensation in her throat. On analysis, the beer was found to contain hydrochloric acid. Life was not endangered, and no grievous bodily harm was done. The prisoner was convicted of the misdemeanour of administering poison with intent to injure, aggrieve, and annoy.

POISONING BY HYDROFLUORIC ACID (HF).

Source and Method of Occurrence.—The acid is manufactured for the purpose of etching on glass. The only case on record since 1893 is the one reported below, due to misadventure.

Toxicity and Fatal Dose.—The acid would certainly be a violent poison, both in itself and also because the commercial acid contains sulphuric acid. The manufacturer of the acid which caused the death below wrote thus to Sir Thos. Stevenson: "Hydrofluoric acid as usually supplied to glass engravers contains about 40 per cent. of HF.; the sp. gr. varies according to the amount of sulphuric acid present, which comes over unavoidably in making the commercial acid."

The dose in the case was uncertain, "a tablespoonful" or "a half-quartern" being the estimates of witnesses.

Duration.—In the case recorded, death took place within two hours, the symptoms appearing very soon after the swallowing of the dose.

Symptoms.—Vomiting and collapse seem to have been the chief features in the case.

Treatment.—Milk and other demulcent drinks seem to be all that can be done beyond general measures to counteract shock.

Post-mortem Appearances.—*Blood*—Very tarry, but without clots; *lips*—Very charred; *tongue*—Sides denuded of papillæ, dorsum brownish, but not much burnt, back part of the epiglottis and fauces a deep brown colour, congested and ecchymosed; *pharynx*—Purplish slate colour, ecchymosed and congested, tissues round the rima glottidis were reddened and ecchymosed; *œsophagus*—Much congested, the whole of a slate colour, with deep red patches; *stomach*—Cardiac portion markedly ecchymosed, slight ecchymosis towards the pyloric orifice. No perforation and no denudation of mucous membrane of stomach; *intestines*—Nothing abnormal could be detected; *lungs*—Both very much congested and almost black in colour.

The jury found that death arose by misadventure.

Analysis.—That of the usual inorganic tests for HF.

Case.—The case is recorded in the *B. M. J.*, October 21st, 1899, as follows:—An inquest was recently held at Wimbledon with reference to the death of a man, named Joseph Wilson Hollyer, aged fifty-one years. As a sign writer and glass embosser, he had completed some work and retired to a public-house for some refreshment, having with him his tools and indiarubber bottle of hydrofluoric acid, used in his employment. The witnesses on this occasion described him as being quite sober, but "fooling about," the barmaid, with whom he was joking, stating that he first told her that he had some scent, and then that he had some glycerine in the bottle, and would give her some for her hands if she would give him a glass. After a time he seems to have poured out a tablespoonful or "a half-quartern" of the acid into a glass and diluted it with water. Thereupon he held it up, remarking to the barmaid, "This is as harmless as the liquor you sell," and put it to his lips, but did not drink it until he had added more water. Shortly after he was seen to be looking very white and clammy, and assistance was obtained. He was able to speak, and said that he had taken it before, but now had taken too strong a dose, and asked for milk to kill the acid. This was given him, but without effect, and after some vomiting, he was removed to the Cottage Hospital, where he died about an hour afterwards, previously stating that he had taken it "for foolery."

His wife, in evidence, stated that she had heard her husband say that one drop of the acid was good when taken medicinally, but he know it was a deadly poison; he had never threatened suicide.

Medical evidence showed that death was due to shock and collapse caused by the acid.

Verdict: Death by misadventure.

A case is also reported in the *Lancet*, February 8th, 1893, p. 203, in which half an ounce was taken, and death occurred in two hours (Patholog. Soc. Meeting, January 21st, 1893).

On this case Sir Thos. Stevenson wrote to the *B. M. J.*, 2, 1899, p. 1376:—

"Poisoning by this acid is rare. So far as I can ascertain, there have hitherto been only three cases of death from its use. One of these is recorded by Dr. King. Half a fluid ounce was swallowed, and death ensued in twenty-three minutes, apparently from the closing of the glottis by shreds of mucous membrane. Some years ago a suicidal death was registered as having occurred from the taking of the acid; but I have been unable to gain any particulars of the case. The third case is the one recorded in the *B. M. J.* of October 21st. I have examined the acid used in this case, and find it to be a weak acid, containing 9·2 per cent. only of HF. The commercial acid as sent out to glass engravers is, I am informed, usually sent out of at least four times this strength. The highly corrosive effects of commercial hydrofluoric acid are familiar to all chemists, but it would seem that the toxic effects are not exclusively due to this property." The quantity of the acid taken in this case cannot be stated with any certainty; it may have been as much as two fluid ounces or as little as half an ounce of the solution (9·2 per cent.).

POISONING BY PYROGALLIC ACID.

Source and Method of Occurrence.—The acid, which is largely used for the purposes of photography, is imported from Germany, where it is termed "pyrogallolium," in crystals packed in blue glass bottles and not labelled poison. Very few cases of poisoning by it are recorded for human beings. The author did not meet with any case of poisoning by it in the human subject; but, according to Personne, it operates powerfully on animals. Two healthy dogs were selected, and into the stomach of one a dose of two grains of pyrogallin dissolved in water was injected; and twice this quantity was administered to the other dog. The animals died after fifty and sixty hours respectively. The symptoms are said to have resembled those of phosphorus-poisoning, and after death the muscular tissue of the heart was found in each case to have undergone fatty degeneration. The acid is supposed to act like phosphorus in arresting oxidation changes by absorbing and removing oxygen. The alkalinity of the blood would favour this chemical action (*Med. Press*, December, 1869; *Amer. Jour. of Med. Sci.*, July, 1870, p. 275). Neisser reported a case of fatal intoxication following inunctions of one half the body with a 10 per cent. pyrogallic acid ointment (*B. M. J.*, 2, 1898, p. 40).

Toxicity and Symptoms.—The editor leaves the following cases to represent the toxicity and symptoms, etc. The first occurred in 1896.

The Coroner for Sussex, held an inquest on a woman, æt. 24, married and pregnant, who took by mistake for a tonic medicine, a dose of "pyro" stock solution, used in developing photographs: this stock solution is made up (according to the evidence given) of—Nitric acid, 20 minims; pyrogallic acid crystals, 1 ounce; water, 5½ ounces. Of this mixture she took about an ounce and a half, which would correspond to about 120 grains of pyrogallic acid.

When seen at 3 p.m. the next day, her symptoms were as follows: Body and face turned a peculiar yellowish green colour, pulse 75, temperature normal. She vomited violently, and the vomit and also her urine were of a green colour. Repeated attacks of syncope followed, with difficulty in breathing. She complained also of severe pain in the stomach and between the shoulders, and also of a "griping of the heart." She took the dose about 7.45 p.m. on Friday, September 4th, 1896. She aborted on the evening of Sunday, September 6th, and died about 7 a.m. on Tuesday, September 8th.

Post-mortem examination showed: Externally, body of a peculiar yellowish colour. Stomach corroded all over, especially at the œsophageal entrance. Perforation about one inch from œsophageal entrance. Contained about 3 drachms of a dark coffee-coloured fluid, smelling of ether. (Had taken ether to relieve pain, also hypodermic injections.)

Lungs.—Normal. *Heart.*—Normal. *Uterus.*—Slightly enlarged and right ovary congested. Contained a little congealed blood. Otherwise normal. Commencing signs of peritonitis.

Cause of death.—Perforation of the stomach, shock, syncope.

The second is thus reported in the *B. M. J.*, 2, 1897, p. 81, by Dr. Reilly, of London:—

On May 1st, at 10 a.m., I was summoned to Mrs. H. M., æt. 32, supposed to be dying.

Her condition on my arrival was as follows: Her face was of a dirty grey colour with the exception of her lips, cheeks, and ears, which were dark blue. She was conscious, her pupils normal, and her skin cold. The heart was acting feebly, and she took no notice of anybody, but would answer questions put to her. The tongue was dark brown and dry, and she had vomited for two hours before my arrival, but that had now ceased, and the vomit had been thrown away. She complained of no pain, and exhibited no tenderness on pressure over the abdomen. I found no disease of the heart or lungs, and her mother informed me that she had menstruated a fortnight before. I then asked her relatives to leave the room, and questioned her as to whether or not she had taken poison: this she firmly denied.

The room was then searched and nothing suspicious found except a pudding basin under the bed, which appeared clean.

Large doses of ether, ammonium carbonate, and digitalis were given, mustard applied over the heart, and hot water bottles to the feet, the result being that after some time the heart acted slightly better, but there was very little improvement.

Shortly after diarrhœa set in and continued throughout the day, and the urine which was passed consisted principally of blood.

On May 2nd the diarrhœa ceased, but her appearance was unaltered; she then complained of severe headache but had no other pain, and seemed in a drowsy condition, answering questions when spoken to. Later in the day her mother told her she thought she was dying, and she then confessed that she had taken poison, and that the bottle was hidden under the carpet, where it was at once found. It was an ordinary 1-ounce bottle of pyrogallic acid, used by the father for photography, practically empty, and was said to have been half full the day before. She had mixed the contents with water in the basin found under the bed, and swallowed the fluid.

On May 3rd she was decidedly worse, her face was deathlike, yet she could understand when spoken to sharply. Later in the day she became comatose, and died at 4 a.m. on May 4th, or about sixty-eight hours after the first symptoms were noticed. I tested what little remained in the bottle, and found it to be pyrogallic acid.

At the post-mortem examination all the viscera were intensely congested; the kidneys were of a dark purple colour, the bladder contained blood, the heart cavities were full of clot, and the stomach and intestines showed patchy congestions.

Remarks.—The absence of gastric pain or tenderness after a large dose (½ ounce), the intense cardiac depression, apparently not relieved by the ordinary cardiac stimulants, the cyanosed condition with hæmaturia and the slowness of death, appear to me worthy of notice. I am unable to find any record of death in the human being from this poison.

A third case is thus reported (*Lancet*, 2, 1896, p. 858):—

A woman went into the unlighted dining-room and took a dose of tonic, as she thought, from a bottle on the sideboard. Mr. B. is an amateur photographer, and the damp having affected his chemicals in the harness-room he had placed them on the sideboard. A solution of pyrogallic acid was in a bottle similar to that containing the tonic. Mrs. B., later the same evening, having complained that her medicine was very nasty, was seized with an attack of retching, and said she believed she must have taken the wrong medicine in the dark. Mr. B. said at the inquest that he thought of the photographic chemicals, but did not realise anything serious, being unaware that any of them were violent poisons. The pyrogallic acid was bought in powder and made up into solution according to a formula on the plate boxes. The acid was not scheduled as a poison, nor was it labelled as such by the vendors. Deceased knew the chemicals were on the sideboard, and Mr. B. afterwards ascertained that the deceased must have taken one and a half ounces of the solution. The formula was one ounce of pyrogallic acid and twenty drops of nitric acid to six ounces of water. Another medical man was called in the day after the mishap, but death ensued from perforation of the stomach. The coroner said that Dr. Thos. Stevenson had never known a case of pyrogallic acid poisoning in a human subject. The jury by direction returned a verdict of accidental death, and the coroner intimated his intention of submitting the case to Dr. Stevenson and of suggesting to the Pharmaceutical Society that the acid should be scheduled as a poison.

Analysis.—Pyrogallic acid colours ferrous salts an intense blue, and ferric salts a brownish red; with alkalies it becomes brown very quickly on exposure to air ("Squire's Comp. to the Brit. Pharm.," 1899).

POISONING BY OXALIC ACID.

Source and Method of Occurrence.—Oxalic acid is very largely used in cleaning brass, etc., also in the bleaching of straw. It is also a constituent, though in small amount, of sorrel leaves and some species of Rumex. It occurs, too, in rhubarb, but hardly in poisonous quantities. Accidents to children from eating sorrel are occasionally reported (*vide infra*, "Vegetable Poisons"). It was responsible for seven fatal accidents and for no fewer than seventy-two suicides in the year 1901, but seems never in that year to have been used for homicidal purposes. There were also two suicides in women from oxalate of potash.

Toxicity and Fatal Dose.—The smallest quantity of this poison which has been known to destroy life is **sixty grains**. A boy, æt. 16, took the acid in a solid form, and in about an hour was found insensible, pulseless, and his jaws spasmodically closed. He had vomited some bloody matter; his tongue and lips were unusually pale, but there was no excoriation. He died in eight hours (*Lancet*, 1855, 2, p. 521). In one case *three drachms* destroyed life in an hour. Two cases occurred at Guy's Hospital, in each of which half an ounce of oxalic acid had been swallowed. Active treatment was adopted, and both patients recovered. When the dose is upwards of half an ounce, death is commonly the result; but a case has occurred in which a man recovered after having taken an ounce of the acid. Brush has communicated to the *Lancet* a case in which recovery took place after a similar dose of the poison had been taken (see also a case by Alison in the same journal, 1850, 2, p. 502). The acid was in this instance taken by mistake for Epsom salts. Ellis met with a case in a woman, æt, 50, who swallowed an ounce of the acid in beer. In half an hour she was found complaining of a burning pain in the stomach, and rolling about. Chalk and water were freely given, and she recovered (*Lancet*, 1864, 2, p. 265).

Duration.—In oxalic acid we have a typical illustration of a poison that acts in two distinct ways—first of all by its immediate corrosive action, and secondly, it acts as a powerful poison to nerve structures after absorption. Hence is explained the fact that similar quantities of this poison do not always destroy life within the same period of time. In two cases, in which about two ounces of the acid were respectively taken, one man died in twenty minutes—the other in three-quarters of an hour. Christison mentions an instance in which an ounce killed a girl in thirty minutes; and another in which the same quantity destroyed life in *ten minutes;* but in a third case death did not occur until the fifth day. Ogilvy reported a case of poisoning by oxalic acid, in which it is probable that death took place within *three minutes* after the poison had been swallowed. The sister of the deceased had been absent from the room about that period, and on her return found her dying; "almost immediately" is a very common statement of the rapidity of death. The quantity of poison taken could not be determined. Sir Thos. Stevenson has met with cases of death in *fifteen* and *twenty minutes* respectively. When the dose of oxalic acid is half an ounce and upwards, death commonly takes place within an hour. There are, it must be admitted, numerous exceptions to this rapidity of action. Christison reported two cases which did not prove fatal for thirteen hours; and in an instance that occurred to Fraser, in which half an ounce was taken, the individual died from the secondary effects in a state of exhaustion thirteen days after taking the poison. The great differences observed must obviously depend upon the condition of the stomach as regards its readiness for absorption. Oxalic acid is freely soluble in water, and if swallowed in solution on a moderately empty stomach, in which absorption is freely proceeding, it is easy to conceive that death might very rapidly take place from the effect on the heart of the absorbed acid.

Symptoms.—If this poison is taken in a large dose, *e.g.*, from half an ounce to an ounce of the crystals dissolved in water, a hot burning acid taste is experienced during the act of swallowing the poison. This is accompanied by a similar sensation extending through the gullet to the stomach. There is sometimes a sense of constriction or suffocation: the countenance is livid, and the surface of the skin soon becomes cold and clammy. Vomiting occurs either immediately or within a few minutes. Should the poison be diluted, there is merely a sensation of extreme soreness, and vomiting may not occur until after a quarter of an hour or twenty minutes. In some cases there has been little or no vomiting, while in others this symptom has been incessant until death. In a case in which an ounce of the acid was swallowed, the vomiting and pain in the stomach continued until the fifth day, when the man died suddenly (*Lancet*, 1860, 2, p. 509). In a case in which the poison was much diluted, vomiting did not occur for seven hours (Christison on "Poisons"). The vomited matters are highly acid, and have a greenish-brown or almost black colour; they consist chiefly of mucus and altered blood. In one reported instance they were colourless (*Med. Gaz.*, vol. 27, p. 792). In another case fluid blood of a bright arterial colour was vomited after some hours (*Prov. Jour.*, June 25th, 1851, p. 344). There is great pain and tenderness in the abdomen, with a burning sensation in the stomach. There are cold clammy perspirations and convulsions. In a case in which about two ounces of the poison had been swallowed there was no pain. Violent vomiting and collapse were the chief symptoms. There is in general an entire prostration of strength, so that if the person is in the erect position he falls; there is likewise unconsciousness of surrounding objects, and a kind of stupor, from which, however, the patient may be roused without difficulty. The pulse is very feeble. Owing to the severity of the pain, the legs are sometimes drawn up towards the abdomen. The pulse is small, irregular, and scarcely perceptible; there is a sensation of tingling or numbness in the extremities, and shortly before death the respiration is spasmodic. The inspirations are deep, and a long interval elapses between them. Such are the symptoms commonly observed in a rapidly fatal or acute case. In the majority of fatal cases death takes place within an hour.

Should the patient survive the first effects of the poison, the following symptoms may appear: there is soreness in the mouth, constriction and burning pain in the throat, pain in swallowing, tenderness in the abdomen, and irritability of the stomach, so that there is frequent vomiting, accompanied by purging. The tongue is swollen, and there is great thirst. The patient may slowly recover from these symptoms. In a case related by Edwards, the patient, a female, lost her voice for eight days. Another case has been reported by Bradley, from which it may be inferred that a loss of voice may result from a direct effect of oxalic acid on the nervous system. A man swallowed a quarter of an ounce of the acid and suffered from the usual symptoms in a severe form. In about nine hours his voice, although naturally deep, had become low and feeble. The weakness of voice remained for more than a month, and its natural strength had not returned even after the lapse of nine weeks. During the first month there was numbness with tingling of the legs (*Med. Times*, 1850, 2, p. 293). Sir Thos. Stevenson has seen a similar case, in which a man almost lost his voice for some time. The occurrence of the sensation of numbness, and its persistence for so long a period after recovery from the symptoms of irritation, point to the effect of the poison on the nervous system. Spasmodic twitchings of the muscles of the face and extremities have also been observed in some instances (*Lancet*, 1851, 1, p. 329), and even convulsions of a general type. Nephritis may be found (*vide* cases).

Treatment.—There is considerable difficulty in the treatment of a case of oxalic acid poisoning. The first object is, naturally, to neutralise the acid, but if sodium or potassium salts be given for this purpose, it has to be remembered that their oxalates are very soluble and absorbable and also poisonous, hence the administration of these alkalies may defeat its own purpose unless the resultant products are quickly removed from the stomach; water again, which might dilute the acid, is likely only to promote a more rapid absorption. Calcium oxalate is the most insoluble oxalate, and hence chalk or calcined magnesia may be given, or lime water, but even calcium oxalate should be removed as soon as may be.

Again, as regards emptying the stomach, it is better to avoid the use of the stomach-pump owing to the possibility of erosion having taken place; but if vomiting have not taken place naturally something of that sort must be done, as other emetics are not likely to be of service; the stomach mucous membrane is probably insensitive, and a hypodermic emetic would be too risky on account of the very depressing effect of apomorphine.

Time is, too, a very precious element, and what is to be done must be done pretty quickly.

On the whole, whitening and a bit of a ceiling crushed up are the best that will probably be at hand given in a half-tumbler of water and followed by some castor oil.

Diffusible stimulants may also be given either hypodermically or per rectum.

Post-mortem Appearances.—The mucous membrane of the tongue, mouth, throat, and gullet, is commonly white, as if bleached; but it is sometimes coated with a portion of the brown mucous matter discharged from the stomach. This latter organ contains a dark brown mucous liquid, often acid, and having almost a gelatinous consistency. On removing the contents, the mucous membrane will be seen pale and softened, without always presenting marks of inflammation or abrasion, if death has taken place rapidly. The mucous membrane is white, soft, and brittle, easily raised by the scalpel, and presents the appearance which we might suppose it would assume after having been boiled for some time in water. The small vessels are seen ramifying over the surface, filled with dark-coloured blood, apparently solidified within them. The lining membrane of the gullet presents the same characteristics. It is pale or dark, and appears as if it had been boiled in water, or digested in alcohol; it has been found strongly raised in longitudinal folds, interrupted by patches where the membrane has become abraded, and presenting a curious worm-eaten appearance. In a case which was fatal in eight hours the tongue was covered with white specks; the gullet was not inflamed, but the stomach was extensively destroyed, and had a gangrenous appearance. Portions of the mucous membrane were detached, exposing the muscular coat. With respect to the intestines, the upper portion may be found inflamed; but, unless the case is protracted, the appearances in the bowels are not strongly marked. In a well-marked instance of poisoning by this acid, however, which is recorded by Hildebrand, the mucous membrane of the stomach and duodenum was much reddened, although the patient, a girl of eighteen, died in three-quarters of an hour after taking one ounce of the acid, by mistake for Epsom salts (Casper's *Vierteljahrsschr.*, 1853, Bd. 3, p. 256). In a case of poisoning in which two ounces of the acid had been taken, and death was rapid, the coats of the stomach presented almost the blackened appearance produced by sulphuric acid, owing to the colour of the altered blood pigment spread over them. In protracted cases, the gullet, stomach, and intestines have been found more or less congested or inflamed. In a case in which an ounce was swallowed, and death occurred on the fifth day, the stomach was slightly congested, and contained a bloody fluid, but the mucous membrane was entire (*Lancet*, 1860, 2, p. 509).

In one instance the larynx was found filled with frothy mucus, and the left side of the heart and the lungs were gorged with dark-coloured fluid blood. In another, the appearances of sanguineous apoplexy were found in the brain. A person fell dead after retching violently. Apoplexy was supposed to be the cause of death. On an inspection of the body, it was found that a large clot of blood was effused on the brain, and this appeared satisfactorily to account for death. But when the stomach was examined oxalic acid was detected in it. This poison had been taken, and had produced its usual effects. The deceased had taken it with suicidal intention, and the violent vomiting which it caused had led to death by apoplexy from effusion of blood (*Lancet*, 1863, 1, p. 47). [An excellent illustration of the need for a careful autopsy.—Ed.] Without a chemical investigation it is obvious that the real cause of death would have been in this instance overlooked. In a few cases there have been scarcely any morbid appearances produced by this poison.

The glairy contents of the stomach or its coats do not always indicate strong acidity until after they have been boiled in water. Oxalic acid does not always appear to have a strongly corrosive action on the stomach. It is therefore rare to hear of the coats of the organ being perforated by it. In many experiments on animals, and in some few observations on the human subject, the author found nothing to bear out the view that perforation is a common effect of the action of this poison. The acid undoubtedly renders the mucous coat soft and brittle, and perforation of the coats may occur either during life or after death as a result of its chemical action. Wood has recorded the case of a female, æt. 27, found dead, whose death had been obviously caused by oxalic acid, but the quantity taken and the duration of the case were unknown. The stomach presented, at its upper and fore part, near the cardiac opening, an irregular aperture of a size to admit the point of the finger. From this a dark gelatinous-looking matter, resembling coffee grounds, was escaping in abundance. The perforation was enlarged during the removal, and presented the appearance of two large apertures separated by a narrow band. The stomach contained a bloody fluid, in which oxalic acid was detected, and the mucous membrane had an eroded appearance. The small intestines (jejunum and ileum) were similarly affected.

Analysis.—So far as suspecting oxalic acid is concerned, Christison says: "If a patient after swallowing a crystalline substance which tastes strongly acid, is seized almost immediately with violent vomiting, pain in the stomach, feeble pulse, cold sweats, and collapse, and dies within half an hour, or even earlier, there can scarcely be a doubt that oxalic acid has been administered."

Chemical Analysis. In the Simple State.—This acid may be met with either as a solid, or in solution in water. *Solid oxalic acid* crystallises in long slender prisms, which, when perfect, are four-sided. In this respect it differs from other common acids, mineral and vegetable. The crystals are unchangeable in air; they are soluble in water and in alcohol, forming strongly acid solutions. When heated on platinum-foil they melt, and are entirely dissipated without combustion and without being carbonised. Heated gently in a close tube, they melt, and the vapour is condensed as a white crystalline sublimate in a cold part of the tube. The crystals are prismatic, like those obtained from the solution. There should be no residue whatever if the acid is pure; but the commercial acid generally leaves a slight residue of fixed impurity. By this effect of heat, oxalic acid is easily distinguished from those crystalline salts for which it has been sometimes fatally mistaken, namely, the sulphates of magnesium and zinc. These leave white residues in the form of anhydrous salts. A teaspoonful of oxalic acid in small crystals weighs seventy-six grains, and half an ounce of the crystals is equivalent to three teaspoonfuls.

Tests for the Acid in Solution. 1. *Nitrate of Silver.*—When added to a solution of oxalic acid, it produces an abundant white precipitate of oxalate of silver. A solution containing so small a quantity of oxalic acid as scarcely to redden litmus-paper, is affected by this test;

but when the quantity of poison is small, it is always advisable to concentrate the liquid by evaporation before applying the test. The oxalate of silver is identified by the following properties:—It is completely dissolved by cold nitric acid. If collected on a filter, thoroughly dried, and heated on thin platinum-foil, it is dissipated with a slight detonation. When the oxalate is in small quantity, this detonation may be observed in detached particles on burning the filter, previously well dried. 2. *Sulphate of Calcium.*—A solution of oxalic acid is precipitated white by lime water and by all the salts of calcium. Lime water is itself objectionable as a test, because it is precipitated white by several other acids. The salt of calcium which, as a test, is open to the least objection, is the *sulphate.* As this is not a very soluble salt, its solution must be added in rather large quantity to the suspected acid poisonous liquid. A white precipitate of oxalate of calcium is slowly formed. This precipitate should possess the following properties: — (*a*) It ought to be immediately dissolved by nitric or hydrochloric acid. (*b*) It ought not to be dissolved by ammonia, nor by oxalic, tartaric, acetic, nor any other vegetable acid.

In Liquids containing Organic Matter.—The process is the same whether it is applied to liquids in which the poison is administered, or to the *matters vomited,* or, lastly, to the *contents of the stomach.* This poison readily combines with albumen and gelatin, and it is not liable to be decomposed or precipitated by these or any other organic substances. It is, therefore, commonly found in solution in the liquid portion, which will then be more or less acid. As a trial test we may employ either a solution of sulphate of copper or lime water. (1) A portion of the liquid should be boiled to remove any albumen, and after filtration a solution of sulphate of copper should be added to it. If oxalic acid is present in moderate quantity, a greenish white precipitate will be formed. (2) Lime water may be added to a portion of the clear liquid. A white precipitate will be produced, insoluble in acetic acid, if oxalic acid is present.

From milk, gruel, coffee, blood, mucus, and other viscid liquids, oxalic acid is readily separated by the process of dialysis, as described under sulphuric acid. The liquid should be first boiled, the coats of the stomach (cut up) being included, if necessary. The distilled water placed on the outside of the tube will receive the acid. This may be concentrated by evaporation. Prismatic crystals may thus be procured, and the silver and lime tests may be applied. Oxalic acid may be completely separated from the boiled and filtered organic liquid by the following process:—To the filtered liquid, acidulated with acetic acid, acetate of lead should be added until there is no further precipitation, and the white precipitate formed, collected, and washed. If any oxalic acid was present in the liquid, it would exist in this precipitate in the form of oxalate of lead. To separate oxalic acid from the oxalate of lead diffuse the precipitate in water and pass into the liquid, for about half an hour, a current of sulphuretted hydrogen gas, taking care that the gas comes in contact with every portion of the precipitate. Black sulphide of lead will be precipitated, and with it commonly the greater part of the organic matter which may have been mixed with the oxalate of lead. Filter to separate sulphide of lead; the filtered liquid may be clear and highly acid. Concentrate by evaporation; the sulphuretted hydrogen dissolved in the liquid is thereby expelled, and oxalic acid may be ultimately obtained crystallised by slow evaporation in a watch-glass, or on a glass slide, for microscopical observation. If there was no oxalic acid in the precipitate, no crystals will be procured by evaporation. If crystals are obtained, they must be dissolved in water, and tested for oxalic acid in the manner above directed.

The presence of oxalic acid in an organic liquid may be detected by another method. Place a portion of the liquid containing the poison in a beaker, and insert in this a tube secured with skin, containing a solution of sulphate of calcium. By dialysis or osmosis the oxalic acid will penetrate the membrane, and will form inside the mouth of the latter a deposit of crystals of oxalate of calcium, known by their octahedral form.

Sometimes the chemical evidence may depend on *stains* on articles of *clothing*. Oxalic acid discharges the colour of some dyes, and slowly reddens others; but unless the stuff has been washed, the acid remains in the fabric and may be detected there. It does not corrode nor destroy the stuff so readily as mineral acids.

As oxalic acid is very soluble in alcohol, this liquid may be occasionally employed for separating it from the contents of the stomach, and from many organic compounds. Large and perfect crystals may be obtained from the alcoholic solution, and these may be purified and tested by the methods already described.

In cases of poisoning, the residuary quantity found in the stomach is generally small. In one instance, in which about an ounce and a half had been taken, and the person died in two hours, the author found only thirteen grains. In a case which occurred at Bristol in 1868, a woman took upwards of three quarters of an ounce of oxalic acid (360 grains), and died in ten minutes. It is stated that not more than two grains were obtained from the coats of the stomach. The vomiting had been violent, and the greater part of the poison had been thus ejected. It seems that the woman had vomited into a pail containing calcareous water, and it was observed that this water acquired a milky white appearance, owing to the action of the acid on the salts of calcium (*Chem. News*, April 24th, 1868, p. 205; and *Pharm. Jour.*, May, 1868, p. 543). In *R.* v. *Cochrane* (Liverpool Sum. Ass., 1857), in which it was charged that two children, aged six and four years respectively, had been wilfully poisoned by their mother, it was stated by the medical witness, Edwards, that he found forty-two grains of oxalic acid in the stomach of the elder, and twenty grains in that of the younger child. It was not clearly established when or how this large quantity of poison could have been wilfully administered to the children, and the prisoner was acquitted.

Since the soluble oxalates give the same reactions as oxalic acid itself, to prove the presence of oxalic acid it will be necessary to ascertain the presence of an oxalate, and also to determine the amount of free acid present in the solution submitted to analysis, by titration with an alkali. Since, however, the soluble oxalates are themselves highly poisonous, in practical toxicology it is not always necessary to do this in order to prove that a poison has been taken.

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POISONING BY OXALATES.

Source and Method of Occurrence.—Binoxalate of potash, also called salts of sorrel or salts of lemon, is a commercial product used largely in straw bleaching, etc. Familiarity breeds contempt, and the workpeople frequently keep a solution of it in ginger-beer bottles, etc., and drink it by mistake. Accident is thus the common form of poisoning by this salt.

Toxicity and Fatal Dose.—This salt destroys life almost as rapidly as oxalic acid itself. In one case, half an ounce killed an adult in so short a time as *eight minutes;* but probably the fatal effects were in this instance accelerated by the debilitated state of the person who took it. In another case reported by Chevallier, death took place in ten minutes ("Ann. d'Hyg.," 1850, 1, 162). In one instance in which it was supplied by mistake for Epsom salts, it caused death in an hour and a half (*Pharm. Jour.*, 1873, p. 760). In a reported case (*Edin. Month. Jour.*, July, 1862, p. 93), death appears to have been caused by this salt as the result of chronic poisoning. Out of nine recorded cases of poisoning by this substance, six proved fatal, while in three the patients recovered.

Duration of Symptoms.—In this respect the oxalates resemble very closely the acid itself, except that the irritant action may be less marked, and the symptoms of its depressant effect on the heart after absorption are more marked.

In a case of recovery, a young lady, aged twenty, swallowed an ounce of the salt dissolved in warm water. She was not seen by any one for an hour and a half; she was then found on the floor, faint and exhausted, having previously vomited considerably. There was great depression, the skin cold and clammy, the pulse feeble, and there was a scalding sensation in the throat and stomach, with continued shivering. Proper medical treatment was adopted, and she recovered in two days, but still suffered from debility and great irritation of the stomach. During the state of depression it was remarked that the conjunctivæ of the eyes were much injected, and the pupils dilated. There was also great dimness of vision (*Med. Gaz.*, vol. 27, p. 480).

Treatment.—The same as for the acid, except that the stomach-pump may be used, as there is less fear of corrosion.

Post-mortem Appearances.—In the chronic case mentioned above a girl was charged with the murder of her father. He began to be ill about December 5th, and he died on January 26th following. He suffered from vomiting, heat and irritation in the mouth and throat, prostration of strength, and constant pains in the chest and abdomen. After death the appearances were—inflammation of the mucous membrane of the stomach and part of the bowels. They contained a dark-coloured fluid. The mucous membrane of the gullet was destroyed. The coats of the stomach, which were thickened and injected, had a gangrenous appearance. There was no proof that the prisoner had had possession of the poison until January 11th, five weeks after the symptoms had begun in the deceased. The symptoms before and subsequently to this date were similar. This absence of proof of possession led to the acquittal of the prisoner; still it would be difficult to account for the symptoms and appearances on any theory of disease.

Analysis.—This salt is not very soluble in cold water, but its solution may be readily mistaken for that of oxalic acid. It is not dissolved by alcohol; and this distinguishes it from oxalic acid. (1) The aqueous solution has an acid reaction; and (2) it is precipitated both by nitrate of silver and sulphate of calcium, like oxalic acid; but with the latter test the precipitation is much more copious. It is further distinguished from oxalic acid (1) by its crystals, which, when slowly produced on a glass slide, assume the shape of small rhombic prisms, sometimes grouped in a plumose form, and (2) by heating a portion on platinum-foil. While oxalic acid is entirely volatile, the binoxalate leaves an ash, which, when sufficiently heated, is white and alkaline; it may be proved to contain carbonate of potassium by its dissolving with effervescence in diluted nitric acid, and forming potassium nitrate.

In some instances this poisonous salt has been supplied by mistake for cream of tartar, and has caused death. Cream of tartar, or acid tartrate of potassium, leaves a black alkaline residue when heated in close vessels. Its solution is less acid than that of the salt of sorrel. It is not precipitated by nitrate of silver or sulphate of calcium. The different action of the two salts on writing-ink affords a simple means of identification. The binoxalate immediately discharges the colour of ink when warmed, while the acid tartrate does not possess this property.

In Testing for Oxalic Acid with Calcium Chloride it is advisable to neutralise the acid liquor first with ammonia. The solution will then contain ammonium oxalate, and the reaction becomes more delicate than with the free acid. These reactions are:—

(*a*) With the free acid—

$$CaCl_2 + (COOH)_2 = Ca(COO)_2 + 2HCl.$$

(*b*) With the ammonium salt—

$$CaCl_2 + (COONH_4)_2 = Ca(COO)_2 + 2NH_4Cl.$$

The white precipitate consists in either case of calcium oxalate, but the by-product is in (*a*) free HCl and in (*b*) ammonium chloride. Now calcium oxalate is soluble in free hydrochloric acid and therefore solutions too dilute to show reaction (*a*) will show reaction (*b*). The precipitated calcium oxalate when collected and washed should have the following properties:—

1. It is insoluble in dilute acetic acid.
2. It is soluble in dilute hydrochloric acid.
3. Dried and ignited on platinum-foil, it is converted first into chalk and finally into lime, which, placed on red litmus paper and moistened with distilled water, strikes a blue spot on the paper.
4. Heated with strong H_2SO_4 in a test tube, it dissolves without charring and evolves CO and CO_2. A blue flame due to the CO appears in the tube if a lighted match is held to the mouth.
5. If it is warmed with a little dilute H_2SO_4 and if then potassium permanganate solution is added, drop by drop, to the hot liquid, the red colour is at first entirely discharged and continues to be so until the oxalate has been entirely converted, when a permanent pink colour denotes the end of the reaction. If the permanganate solution is of the usual standard strength (3·16 grams. per litre) and has been added from a graduated burette, we may now quickly calculate the quantity of oxalic acid, with quite sufficient accuracy for practical purposes, by remembering that 1 c.c. of the standard is decolorised, under these circumstances, by ·0063 grammes of crystallised oxalic acid.

Cases.—In March, 1894, an inquest was held at St. Helens, Lancashire, on a man who "took something out of a cup" and died in less than half an hour. The contents of the stomach responded to the tests for oxalic acid, and enormous quantities of oxalate crystals were found in the urine, but there was no erosion nor even inflammation of the stomach nor of any part of the alimentary tract. There was no evidence to show how or whence the acid was obtained, and, except for the rapidity of death, the case was doubtfully one of oxalic acid poisoning. It seems most probable that there was an accidental mixing of oxalic acid with Epsom salts, which deceased thought he was taking. The dose was taken on an empty stomach early in the morning, which probably accounts for the rapid death. The quantity swallowed was quite problematical.

Dr. Hale White showed before the Pathological Society in March, 1896, two cases of acute nephritis (one proved fatal) produced by oxalic acid poisoning.

In *R.* v. *Morris* (C. C. C., December, 1866) it was proved that the prisoner had attempted to administer a liquid poison forcibly to her daughter, a girl aged six years. The liquid was sour in taste, made the girl's lips smart, and caused vomiting. There was dryness of the lips, and inflammation of the lining membrane of the mouth. No portion of the substance administered could be procured, but a crystalline deposit of oxalic acid was obtained from some stains on the dress of the child. The woman was convicted.

White published a report of a case of poisoning with oxalic acid in which the symptoms and appearances are contrasted with those caused by disease, and compared with those usually assigned to oxalic acid. The poison was not detected in the contents of the stomach, but the sheets on which the patient had vomited yielded one or two grains of oxalic acid. The patient lived forty hours after vomiting had set in (*Boston Med. and Surg. Jour.*, January 27th, 1870).

POISONING BY CARBOLIC ACID, PHENOL, OR PHENIC ACID.

Source and Method of Occurrence.—Since the discovery of its antiseptic properties carbolic acid has been manufactured in enormous quantities from coal tar. The pure acid is a crystalline body. It has a characteristic, and not unpleasant, odour. When a small proportion of water is added to the crystals, they liquefy. It is moderately soluble in water. The commercial crystals have an unpleasant odour, which is due to impurities; and they slowly acquire a red colour on exposure to light. They melt at about 91° F. More commonly carbolic acid is met with as either a colourless or more or less light brown liquid, of peculiar odour, containing about 80 per cent. of phenol, or as a dark brown liquid chiefly consisting of heavy oil of tar with about 30 per cent. of the acid. These are largely used as disinfectants. Carbolic acid, so called,, does not redden litmus paper. Deaths from the internal use of carbolic acid—usually accidental, but not infrequently suicidal—are common. In 1891, the deaths of ninety-five persons were registered in England and Wales from this poison. In 1901 thirty-three fatal accidents and no less than 142 suicides were due to it.

The *Pharmaceutical Journal* takes annual notice of deaths from poison from the point of view of scheduling poisons. Carbolic acid, up to 1898 at any rate, was not scheduled. The following paragraph is taken from the *Pharm. Jour.*, March, 1900, p. 346 :—

"The Case of Carbolic Acid, as presented in the Registrar-General's report, still continues to be a glaring scandal, the number of deaths caused by it—a very large proportion of which could certainly be prevented if the poison were scheduled—being more than one-sixth of the total number of deaths caused by poison, as shown by the following table, which includes figures for seven years in succession:—

Cause of Death.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
Carbolic Acid	106	148	202	258	197	219	206
Other Agents	709	819	889	920	894	980	911
Total Deaths	**815**	**967**	**1091**	**1178**	**1091**	**1199**	**1117**

"During those seven years the proportion of deaths by carbolic acid poisoning has increased from 13 to 18·4 per cent., and it is noteworthy that the great increase during those years has been in the case of suicides, the number of accidental cases remaining almost stationary, as witness the following statement:—

Group.	Poison.	1892.	1893.	1894.	1895.	1896.	1897.	1898.
Accidents	Carbolic Acid	33	31	35	34	34	43	37
	Other Agents	481	566	553	564	585	648	583
		514	**597**	**588**	**598**	**619**	**691**	**620**
Suicides	Carbolic Acid	73	117	167	224	163	176	169
	Other Agents	228	253	334	356	309	328	325
		301	**370**	**501**	**580**	**472**	**504**	**494.**"

The *Lancet*, 2, 1903, p. 1308, comments on the same subject as follows:—

"In the *Lancet* of October 17th, p. 1113, attention was called to the frequent occurrence of carbolic acid as a means of suicide or as a cause of accidental death. A very similar case to the one then commented upon was inquired into at the coroner's court at Battersea on October 31st. The evidence showed that the deceased, the wife of a clerk, had two bottles in her bedroom, one containing whisky and the other carbolic acid, and that in the dark she poured carbolic acid into a cup and swallowed it, believing it to be whisky. There was no evidence pointing to suicide, and when first found she said that she thought she had 'taken something in mistake.' The woman's husband stated that she was sober at the time, but 'had been rather a heavy drinker, and had lost her sense of taste somewhat.' It is easy to understand that many consumers of whisky are indifferent as to the nature of the grain from which their beverage is distilled, and as to questions of maturity when one who is only 'rather' a heavy drinker cannot either by taste or smell distinguish carbolic acid from it in the dark. To devise precautions that will protect such persons seems to be almost impossible. A stopper of peculiar construction rendering it more difficult to remove than the ordinary cork or stopper might be devised and insisted upon at the sale of poisonous drugs. Such a contrivance would enforce the attention of the person opening the bottle more effectually than the fact of its differing from other bottles to the touch. The use of a particular bottle or stopper, however, cannot be enforced after the completion of the purchase."

Again, in the *Chemist and Druggist* for July 2nd, 1898, the following paragraphs occur:—

"*Carbolic in a ginger-beer bottle.*—On June 23rd Joseph Hill, a shingler, of Hulland, Brockmoor, drank the contents of ½-gal. stone bottle, which he thought contained home-made ginger-beer. The bottle, however, contained carbolic acid, which had been used for disinfecting purposes."

"*The coroner and the sale of carbolic acid.*—On June 20th Dr. George Danford Thomas held an inquest at the St. Pancras Coroner's Court on the death of Mary Ann Hannard (fifty-four), who had committed suicide by taking carbolic acid, which she had purchased from an oil-shop in the neighbourhood. Dr. Richard P. Long, who had been called in, pointed out to the coroner that the bottle in which the poison was sold was not labelled in any way. The coroner said that at oil-shops carbolic, spirit of salt, and other poisons were sold at present, even to children, in any vessel they chose to take, without the slightest precaution being taken. There was no doubt that the Legislature, when the Sale of Poisons Act was passed, never contemplated that poisons would be sold in such small quantities, and, not wishing to hamper commerce, did not include carbolic acid. He did not see that there would be any harm done by the Government including it and some of the other common poisons sold by oil-shop keepers under the second schedule of the Sale of Poisons Act. A juror pointed out that in the House of Lords that day the Poisonous Substances Bill was being considered. Another juror believed the reason action had not been taken was because the Pharmaceutical Society was opposed to it. The coroner said that was not so; it was the Privy Council who refused to give power for carbolic acid being placed in the schedule. On many occasions juries had sent recommendations to the Home Secretary calling attention to the indiscriminate sale of poisons by oil-shop keepers and others, and to the necessity for an amendment of the Act."

These and many similar cases have at last borne fruit, and now phenol and its preparations are put in Schedule II. (*vide* p. 302).

In 1908, out of 1,245 deaths from poisons carbolic acid was responsible for 122.

Toxicity and Fatal Dose.—The official dose of the acid is one to three grains, so that *per se* it does not deserve to be ranked amongst the very dangerous poisons, it is its universal use as a domestic disinfectant, and the ease with which it can be obtained in large quantities, that constitute its danger. There is reason to believe that if absorbed, a few grains of the poison might prove fatal, and eighty grains have killed an adult. Two fluid drachms of the liquid acid have killed a child two years of age in twelve hours (Guy's Hosp. Rep., 1867, p. 233). In one case a child, six months old, was killed by the administration of **a quarter of a teaspoonful** of the acid dissolved in glycerine—one part of acid to five of glycerine (*B. M. J.*, May 20th, 1882). Recovery has, however, taken place after large doses have been taken. A girl, æt. 14, swallowed six fluid drachms of the undiluted (? 30 per cent.) acid. In twenty minutes she was comatose and breathing stertorously; her face was livid, the pulse was small and irregular; the pupils contracted, but not so much so as in opium poisoning. The stomach was washed out with soap and water, and then with milk and water. In an hour, the lividity diminished, and consciousness slowly returned. She did not complain of any gastric irritation (*B. M. J.*, 1882, 1, p. 939). For a further discussion of the fatal dose, *vide Deuts. Med. Woch.*, April 21st, 1898.

Duration.—The symptoms usually come on immediately when the acid has been swallowed in poisonous amounts. Death has occurred almost immediately, **within three minutes** and several times within twenty minutes of the administration of the poison; and it usually supervenes within four hours. Occasionally, in fatal cases, life may be prolonged for twenty-four and even forty-eight hours. Dr. Littlejohn reports a death in fifteen to twenty minutes (*Lancet*, 2, 1900, p. 176).

Symptoms.—As with so many other poisons, there are two classes of cases in carbolic poisoning:—1. The acute form; 2. The subacute or chronic. The latter might perhaps be better styled the untoward effects of carbolic acid when administered medicinally.

In the Acute Form.—When the poison is swallowed in solution, or in the form of an undiluted liquid, the patient experiences a hot burning sensation, extending from the mouth to the stomach. This feeling is experienced during the act of swallowing; and the lining membrane of the mouth is white and hardened. Carbolic acid is rapidly absorbed, and in the course of a few minutes the system may be profoundly affected. In two instances the rapidity of action was comparable to that of prussic acid. Although the local application of the acid to a part is commonly followed by severe burning pain, this may be entirely absent in cases of poisoning by this agent, and even a local diminution of sensibility may be produced. This and also the fact that vomiting is often absent, is due to the now well-known fact that carbolic acid rapidly anæsthetises the part to which it is applied. Nervous symptoms are those most strikingly manifested, such as delirium, giddiness, and profound insensibility. Nausea and vomiting were present in not more than one-fifth of the observed cases. These symptoms may, however, be severe and uncontrollable. There is extreme feebleness of the pulse, and dry harsh skin, with lividity of the surface. The pupils are generally minutely contracted. Convulsions and trismus are not infrequently observed.

In the subacute or chronic form the symptom that arrests attention is the peculiar discoloration of the urine. This was first pointed out by Sir Thos. Stevenson in 1868, but owing to the extremely prevalent use of the acid in the early eighties for the dressing of wounds, it was soon observed by very many practising surgeons. It was a danger signal and commonly disappeared with the discontinuance of the use of the acid. It is, however, often observed in cases that prove fatal. It was commonly the only symptom, but sometimes more serious features were added, such as giddiness or drowsiness.

A case of carbolic acid poisoning can rarely fail to be recognised.

In the acute cases the whitening of the mouth, the brown eschars which form on the skin at its angles where the poison trickles from the mouth, the odour of the breath, and the profound insensibility and stertorous breathing, with minutely contracted pupils, rarely leave any doubt as to the nature of the case. Sir Thos. Stevenson has, nevertheless, met with a case in which a rather pure form of the acid having been taken for suicidal purposes, the odour of carbolic acid escaped notice. In the chronic cases the urine is the characteristic feature which cannot escape observation. A death is stated to have occurred from the external use of the acid (*Brit. Med. Jour.*, 1870, 2, p. 382); and its use as an antiseptic lotion has repeatedly produced serious, if not fatal, results.

Treatment.—The corrosive action of carbolic acid is not very marked, and therefore a soft tube may generally be used with care, but it must be remembered that the anæsthetising action of the acid may prevent the operator knowing that the tube is doing damage. After emptying, the stomach should be well washed out with lukewarm water, in which some magnesium sulphate, or saccharated lime, may with advantage be dissolved, in order to afford an opportunity for the phenol to combine and form an innocuous ether-sulphate. White of eggs and milk may be given. Olive oil has been recommended, but with doubtful advantage. Several observers have noticed that apomorphine failed to produce emesis in phenol poisoning. External warmth, with stimulants such as ether administered hypodermically, or alcohol by the mouth or rectum, are of great value. If death from respiratory paralysis appears imminent, breathing should be promoted artificially (Mann).

Post-mortem Appearances.—Stains produced by the poison may be present at the angles of the mouth and on the chin, and its odour may be perceptible. The mucous membrane of the mouth may be softened, and either white or ash-grey in colour, that of the œsophagus being similarly affected in parts; on account of shorter period of contact, the changes in the mouth and œsophagus are not usually so well marked as those in the stomach. The peritoneal surface of the stomach may be injected, its mucous coat usually being corrugated, toughened, and of a brown colour; in parts it sometimes appears stiff and leathery as though it had been tanned; in other instances it is softened and easily detached. It has been observed to be of an ash-grey colour with small hæmorrhagic points; actual erosion is uncommon. Blood-stained mucus has been found in the stomach. The duodenum may present a similar appearance, the brown colour being sometimes limited to the summit of the valvulæ conniventes; in a preparation in the Museum of Owens College this is well shown in the form of a series of parallel brown lines running across the bowel for fully twelve inches (Mann).

Analysis.—Carbolic acid gives a purple colour when a drop of solution of ferric chloride is added. When in solution, it yields a copious precipitate of tribromophenol, when an excess of bromine-water is added. This precipitate when washed on a filter, and treated in alcoholic solution with sodium amalgam, again yields phenol (carbolic acid). When treated with strong nitric acid, carbolic acid yields a brown colour, changing to green, and ultimately to a fine blue.

To detect phenol in the viscera, vomit, urine, etc., acidulate the suspected material with sulphuric acid, and distil, using a suitable condensing arrangement. The distillate may have the odour of phenol. It is precipitated with an excess of bromine-water; the precipitate is washed with water on a filter, and whilst still moist dissolved in alcohol, treated with sodium amalgam. After a time, on acidifying the solution, the peculiar odour of carbolic acid will be perceived. By shaking the mixture with ether, pipetting off the ether, and evaporating it in watch-glasses, oily streaks of phenol will be left; these may be tested with ferric chloride, as described above.

A distillate containing phenol, made alkaline with ammonia and warmed with solution of bleaching powder, develops a fine green to blue colour.

Cases.—In such a common poison it is useless to quote cases unless they present unusual features.

Early in 1904 the editor saw, in consultation, a small Jewish baby suffering from carboluria, the effect of the external application of carbolic lotion after circumcision. The child died within twenty-four hours of his visit; there were no pathological changes discovered on autopsy visible to the naked eye, but the condition of the urine was unmistakable. It is probable that this accident occurs more commonly than is suspected, for the editor has had one other such case recently communicated to him. *Vide*, for another, *Lancet*, 1, 1904, p. 1279.

A robust woman, æt. 30, swallowed nearly half an ounce of an alcoholic solution of carbolic acid, containing 35·8 per cent. of the poison. It was ascertained by the use of the stomach-pump that rather more than half of the poison was removed from the stomach, but that at least ninety-two grains of the poison must have remained for absorption. The most prominent symptoms were insensibility within ten minutes, and dizziness speedily passing into profound coma, irregular breathing and pulse, contracted pupils, extreme blueness (cyanosis) of the surface of the body, depression of the body temperature to 94° Fahr., and hæmoglobinuria, *i.e.*, the presence of unaltered blood-pigment in the urine, which contained no red blood-corpuscles. This last condition set in one hour after the poison was taken, and lasted for seven hours and a half. The urine gave the reaction for carbolic acid for two days. The woman recovered (*Berlin Klin. Wochenschr.*, 1881, No. 48). This narcotising effect of the acid is by no means an uncommon feature and may lead to a suspicion of opium poisoning.

POISONING BY CAUSTIC POTASH OR SODA AND THEIR CARBONATES (KHO OR NaHO AND Na_2CO_3 AND K_2CO_3).

Source and Method of Occurrence.—All are very largely used in the arts, and consequently prepared in enormous quantities for commerce. Cases of poisoning by them are mostly accidental, but there is no reason why they should not be used criminally, except the obviousness of their use. Pearlash and soap lees consist largely of these caustics. Seven deaths occurred from them in 1891 and four in 1901.

Toxicity and Fatal Dose.—As with other corrosives, concentration has more to do with their toxicity than has the actual dose. The quantity required for a fatal dose is unknown, but **forty grains** of caustic potash has proved fatal. The metals themselves are constituent parts of the human body, and it is probable that the portion of any of these substances that has become absorbed is practically negligible; they kill only by local action in most cases. The pharmacopœial doses are, of liquor potassæ (6·2 grains in 110 minims) ten to thirty minims freely diluted, of carbonate of potassium five to twenty grains, of carbonate of sodium five to thirty grains.

Duration.—In acute cases the symptoms come on at once, and death takes place in a few hours. The most rapidly fatal case reported is that of a boy, who died **three hours** after swallowing three ounces of a strong solution of carbonate of potassium. In a case which occurred in 1835, a child, aged three years, took a small quantity of a concentrated solution of pearlash which had deliquesced, and died in twenty-four hours. Death was caused in this instance by the inflammation induced in the larynx, causing suffocation. In this respect, the caustic alkalies may destroy life rapidly, like the mineral acids; but death may be also a slow result of these poisons. Thus a lady swallowed by mistake one ounce and a half of the common solution of potash of the shops, which contains about 5 per cent. of caustic alkali. She recovered from the first symptoms of irritation, but died seven weeks afterwards from exhaustion, becoming greatly emaciated before her death. The alkali had probably destroyed the lining membrane of the stomach, and had thus impaired digestion.

Such prolonged cases are by no means rare, but they have the characters of an ordinary chronic gastric ulcer.

Symptoms.—The patient experiences, during the act of swallowing, an acrid caustic taste, owing to the alkaline liquid, if sufficiently concentrated, excoriating the mucous membrane. There is a sensation of burning heat in the throat, extending down the gullet to the stomach. Vomiting is not always observed; but when it does occur, the vomited matters are sometimes mixed with blood of a dark brown colour, and with detached portions of mucous membrane: this effect depending on the degree of causticity in the liquid swallowed. The surface is cold and clammy: there is purging, with severe pain in the abdomen, resembling colic, usually associated with great tenderness on local pressure, but in one recorded case this was absent. The pulse is quick and feeble. In the course of a short time, the lips, tongue, and throat become swollen, soft, and red. The later or after-effects are those of stricture of the œsophagus, viz., pain or discomfort and difficulty in swallowing solids or even liquids, and of ulcer of the stomach, viz., pain after taking food, often associated with vomiting, which may be very persistent.

Treatment.—This must be directed to neutralising the alkali by means of weak acids. Lemon juice, or vinegar, will probably be obtainable, and should be given, followed by demulcents, such as linseed tea, etc. The stomach-pump must on no account be used, owing to the danger of corrosion. Morphia and hypodermics of ether may be given to counteract the pain and collapse.

Post-mortem Appearances.—In recent cases there are marks of the local action of the poison on the mucous membrane of the mouth, throat, and gullet. This membrane has been found softened, detached, and inflamed in patches of a deep chocolate colour—sometimes almost black. A similar appearance has been met with in the mucous membrane of the larynx and windpipe. The stomach has had its mucous surface eroded in patches, and there has been partial inflammation. In one instance, as a result of the action of soda, the author found it puckered and blackened.

In 1891 Sir T. Stevenson gave evidence as to the death of a woman who died a few hours after drinking a 30 per cent. solution of caustic potash in mistake for iodide of potassium. The stomach was found after death in parts almost completely dissolved.

Barclay has reported a case of poisoning by potash, which furnishes a good illustration of the after-effects and appearances caused by this poison. A woman, aged forty-four, was admitted into hospital about six hours and a half after she had swallowed a quantity of American potash, probably a saturated solution of carbonate of potassium (American pearlash). She had vomited immediately after taking it. The mouth and throat were much corroded. She died from starvation on July 8th, about two months after taking the alkali. On inspection, the lower part of the gullet was found much contracted, the lining membrane entirely destroyed, and the muscular coat exposed. The external coats were much thickened. The cardiac end of the stomach, where the ulceration ceased, was considerably contracted. At the intestinal end the mucous lining presented a large and dense cicatrix, obstructing all communication with the bowels, except by an orifice no larger than a probe. The intervening portion of the stomach was healthy as were also the large and small bowels (*Med. Times and Gaz.*, 1853, 2, p. 554).

Chemical Analysis.—Solutions of caustic potash and soda have a strongly alkaline reaction; they are distinguished from those of their respective carbonates by giving brown precipitates with a solution of nitrate of silver. The carbonates, on the other hand, yield a whitish-yellow precipitate. Potash is known from soda by the following characters:—1. Its solution, when not too much diluted with water, and acidified with hydrochloric acid, is precipitated of a canary-yellow colour by platinic chloride. 2. It is precipitated in granular white crystals, on adding the alkaline liquid gradually to excess of a strong solution of tartaric acid, containing a small quantity of alcohol, and occasionally stirring the mixture. Soda is not precipitated by either of these tests, which will serve equally to distinguish the salts of potash from those of soda, if we except the acid oxalate and acid tartrate of potassium: these, from being but little soluble in water, are not precipitated. 3. If we neutralise the two alkalies by diluted nitric acid, and crystallise the liquid on a slip of glass,—should the alkali be potash, the crystals will have the form of long, slender fluted prisms; if soda, of rhombic plates. 4. Potassium and its salts are known by their giving a reddish-violet colour, while sodium and its salts give a bright yellow colour to a colourless gas or spirit flame.

In Liquids containing Organic Matter.—Such liquids are frothy; they possess an alkaline reaction, a peculiar alkaline odour, and are soapy to the feel. The organic liquid may be evaporated to dryness, then heated in a porcelain capsule to char the animal and vegetable matters, and the alkali will be recovered from it in a state of carbonate by digesting the residuary ash in distilled water.

Cases.—In December, 1867, a case of poisoning by pearlash gave rise to a trial for manslaughter at Manchester (*R.* v. *Boothman*). A solution of this substance had been prepared for washing purposes. The prisoner offered some to a man, who tasted it and immediately called for water. The deceased took some, and was soon afterwards seen in the yard vomiting and in great pain. This was on May 31st; he was admitted into a hospital, where he remained until August 2nd, suffering all the time and unable to swallow anything but thin fluids. On leaving the hospital he went home and died on September 20th, nearly four months after swallowing the alkaline liquid. He died from starvation, as a result of stricture of the gullet. The quantity taken was unknown, but the liquid was sufficiently strong to soften and destroy the mucous membrane of the throat.

Orfila refers to two cases of poisoning by carbonate of potassium, in each of which half an ounce of this substance was taken by mistake for aperient salt. The patients, two young men, recovered from the first effects, but ultimately died: the one three months, and the other four months, after the poison had been taken. The secondary fatal effects appear to have been due to constant purging, great irritability of the stomach leading to incessant vomiting, and loss of the functions of this organ from the destruction of the lining membrane, with stricture either of the gullet or of the apertures of the stomach,—either of which causes might prove fatal at almost any period. A fatal case of stricture, produced by soap-lees after the lapse of two years and three months, is reported by Basham (*Lancet*, 1850, 1, p. 275). The constant use of the alkalies or of their carbonates appears to be productive of insidious mischief: yet the quantity which may be sometimes taken in divided doses without destroying life is enormous. Tunstall relates the case of a man who, for eighteen years, had been in the habit of taking bicarbonate of sodium to remove dyspepsia. It is stated that for sixteen years he took *two ounces* of the bicarbonate daily. The man died suddenly, and on examining the stomach it was found to be greatly distended and extensively diseased—conditions which were referred by Tunstall to the action of the carbonate (*Med. Times*, 1850, 2, p. 564). [It is very doubtful whether the bicarbonate had anything to do with the case, as chronic ulcer of the stomach is known to be capable of lasting many years.—Ed.]

POISONING BY AMMONIA AND ITS CARBONATE (NH_3HO AND $(NH_4)_2CO_3$).

Source and Method of Occurrence.—The caustic solution of ammonia and the carbonate are common articles of commerce. As drugs, too, they are both in common use as sal volatile: it is contained in several liniments and other preparations which are poisonous in large doses. Owing to the strong smell it is almost unknown for ammonia to be used homicidally, but there is one instance on record in which a man was tried for the murder of a child by administering to it spirits of hartshorn (*R.* v. *Haydon*, Somerset Spring Ass., 1845). Occasionally suicides use it, but most of the cases are "Misadventure" when drunk, or from attempts to rouse people in fits, etc. In 1901 eleven suicides chose ammonia, and seven fatal accidents occurred from it. Below will be found a case in which the fumes killed an old man who was using ammonia for cleaning some metalwork.

Toxicity and Fatal Dose.—Ammonia as a caustic resembles nitric and hydrochloric acids in that it is extremely volatile, and consequently easily obtains access to the air-tubes, where it sets up inflammation if the vapour be very strong or the application long continued, with symptoms that are certainly alarming and may easily be fatal. At the same time it is not so virulent as the acids.

The fatal dose is quite unknown, chiefly owing to the rapid deterioration of solutions of ammonia, so that similar quantities of the liquid contain very dissimilar quantities of the real AmHO. In one case from one to two drachms of solution of ammonia caused death. In another instance, a man walked into a druggist's shop and asked for a small quantity of ammonia, to take spots out of his clothes. The druggist poured about a teaspoonful and a half into a glass. The man suddenly swallowed it, and fell instantly to the ground. He soon afterwards died, complaining of the most excruciating pain (*Jour. de Chim. Méd.*, 1845, p. 531). Iliff reported the case of a little boy, aged two years, who swallowed about half an ounce of a strong solution of spirit of hartshorn, and in spite of rather severe symptoms recovered in a few days (*Lancet*, 1849, 2, p. 275). Luff, "For. Med.," states that a drachm of the strong solution has proved fatal. The Pharmacopœia gives no official dose to liquor ammoniæ, nor to the liq. ammon. fort., and fixes three to ten grains as that of the carbonate.

Duration.—So far as onset is concerned, those symptoms which are pulmonary in origin usually occur at once. Gastric symptoms, too, will come on at once when the stomach is empty. When once the acute symptoms have passed off, there is, as in other corrosives, practically no limit to the duration of the case, which becomes one of chronic simple ulcer of the stomach. In one case a strong dose of the solution killed a man in **four minutes**, by causing suffocation (Christison). A case occurred at Halifax in April, 1857 : a man swallowed a large dose of ammonia, and died in a quarter of an hour. In other cases, in spite of a large dose, death has taken place slowly. Potain met with an instance in which a man swallowed upwards of three ounces of the commercial solution of ammonia, and he did not die from the effects until the eleventh day (*Jour. de Chim. Méd.*, 1862, pp. 311 and 474). A man swallowed by mistake, for a dose of cod-liver oil, a tablespoonful of solution of ammonia. Œdema of the glottis followed, and in five hours he died from suffocation (*Lancet*, 1870, 1, p. 467).

Symptoms.—The strong *solution* of ammonia produces symptoms similar to those described in speaking of potash. The only difference observed is, that the sense of heat and burning pain in the throat, gullet, and stomach is much greater. The suffocation, too, is usually much more marked, for serious injury to the organs of respiration is often the result of the action of this poison. In fact, in most fatal cases death is caused by the effect of the fumes upon the glottis and air-tubes. The solution or the fumes cause a rapid inflammation with much swelling, and this naturally causes very severe asphyxia, for the fumes can easily penetrate along the bronchi, leaving a track of this swelling even to the finest tubes.

Vomiting is a prominent feature, and this only makes the asphyxia worse.

Treatment.—The same as for caustic potash so far as the stomach is concerned. Tracheotomy may help for the pulmonary symptoms, but is not very hopeful, as the trouble has probably reached below the glottis. So surely is this the case that one would advise against the operation were it not that it is, humanly speaking, impossible to see a man die from asphyxia without trying to open the windpipe, however hopeless one may know it to be.

Post-mortem Appearances.—In one case, the viscera presented strong marks of corrosion. The mucous membrane of the tongue was softened, and had peeled off; the lining membrane of the air-passages was softened and covered with layers of false membrane, the result of inflammation, and the larger bronchial tubes were completely obstructed by casts or cylinders of this membrane. The lining membrane of the gullet was softened, and at the lower part, near its junction with the stomach, the tube was completely dissolved and destroyed. There was an aperture in the stomach in its anterior wall, about one inch and a half in diameter: the edges were soft, ragged, and blackened, presenting an appearance of solution. The contents of the stomach had escaped. On the inside, the vessels were injected with dark-coloured blood, and there were numerous small effusions of blood in various parts of the mucous membrane. The coats were thin and softened at the seat of aperture. The blackened and congested appearance somewhat resembled that which is seen in poisoning by sulphuric or oxalic acid. The mucous matter on the coats of the stomach was feebly *acid*. No poison of any kind was found in the layer of mucus nor in the coats. There was not in any part a trace of ammonia, the poison which had caused the mischief. [The deceased had lived three days: remedies had been used, and every trace of ammonia had disappeared. *Vide* p. 329.] In another case the mucous membrane of the mouth and throat was destroyed. There was a bloody fluid, smelling of ammonia, in the stomach. At the lower portion, the lining membrane was corroded and the muscular coat changed into a black pulpy substance. The duodenum was also inflamed (*Amer. Jour. Med. Sci.*, January, 1870, p. 275). In 1871 a man was admitted into Guy's Hospital who had swallowed about a teaspoonful of, as was supposed, the stronger pharmacopœial solution of ammonia. He died suddenly not long after admission. The lips, tongue, tonsils, uvula, and pharynx were much swollen, red, glazed, with here and there flakes of white epithelium resting upon the mucous membrane. The gullet was intensely reddened throughout, and at its lower end was of a dark purple colour; but this ceased abruptly at the stomach. The epiglottis and adjacent parts were œdematous. The mucous membrane of the windpipe and bronchi was thickened and injected. Both lungs were œdematous and gorged with blood. Both sides of the heart contained dark fluid blood. There was a circular reddened patch on the mucous membrane of the stomach, at the point on which the liquid would have first impinged; and here the wall of the stomach was thinned (Guy's Hosp. Rep., 1872, p. 225). In the case of a woman who died in about three months from the time at which she had swallowed the poison, the gullet was found healthy; the orifice, at its junction with the stomach, was slightly contracted. The intestinal orifice was contracted to the size of a crowquill, and the coats were thickened. On the posterior wall of the stomach there was a dense cicatrix of the size of half a crown, and from this point fibrous bands ramified in various directions. The duodenum and other parts of the intestinal canal were healthy (*Med. Times and Gaz.*, 1853, 2, p. 554).

Analysis.—The three alkalies, potash, soda, and ammonia, are known from the solutions of the *alkaline earths* by the fact that they are not precipitated by a solution of carbonate of sodium. They all three give a powerful alkaline reaction with test paper, which, in the case of ammonia, is easily removed by heat. Ammonia is immediately known from potash and soda by its odour and entire volatility. *Carbonate of Ammonium* may be known from other salts by its alkaline reaction, its odour, and its entire volatility as a solid:—from pure ammonia—1, by its effervescing on being added to an acid; 2, by its yielding an abundant white precipitate with a solution of chloride of calcium; from the carbonates of potassium and sodium, among other properties—1, by its giving no precipitate with a solution of sulphate of magnesium; 2, by the rich violet-blue solution which it forms when added in excess to a solution of sulphate of copper; 3, by its odour and volatility.

Cases.—Tyerman attended a case in November, 1858, in which a lunatic, æt. 62, swallowed about two fluid ounces of compound camphor liniment, which contains ammonia. The patient immediately complained of great heat in the stomach. Vomiting was induced by giving to him warm water. The uvula, throat, and gullot were so intensely inflamed that he lost all power of swallowing; and the efforts to swallow liquids produced violent retching. The symptoms gradually abated, and the man recovered in four days. In this case the quantity of ammonia swallowed was small, amounting to about two and a half drachms, diluted with about six times that volume of rectified spirit. In 1882 the editor met with a similar case. In September, 1863, Gill met with a case of the poisoning of an infant, only four and a half days old, by a small quantity of this liniment. He saw the infant about half an hour after the liquid had been taken; it was then screaming in a suppressed manner, as if the act increased the pain; the hands were tightly clenched; the skin was pale and covered with a cold perspiration; the mucous membrane of the lips was blistered, and that of the mouth and tongue was white. A yellowish froth escaped from the mouth and nostrils; the breathing was painful, and the pulse imperceptible. In about two hours the infant appeared better, but at intervals it suddenly started and screamed, as if from sudden pain. In six hours it continued much in the same state, and swallowing was painful. In seventeen hours the skin was moist and cool: it had had a natural motion, and had been in a drowsy state during the night. After twenty-four hours the infant was much weaker; the limbs were cold, and the breathing was feebly performed. It became drowsy, and died thirty-two hours after taking the poison. There was an inquest, but no inspection of the body. A question of importance arose in reference to the case, namely, whether the mother or a child, two years of age, criminally administered the poison to the deceased infant. The mother stated that this child was playing with the bottle of embrocation on the bed, on which her infant was lying. She left the room for a short time, and on her return she gave the infant a teaspoonful of food which she had previously prepared for it. She was sure the infant swallowed part of the food; but as soon as the food was taken it screamed violently and struggled for its breath, and then she perceived the food to smell strongly of the embrocation. As from the nature of this irritant compound the symptoms could not be delayed, it is clear that the mother either consciously or unconsciously gave the poison to her infant. On the latter supposition, it must have been placed in the food which was on a chair near to the bed by the child of two years, during her absence; but in this case it is remarkable that she did not perceive the odour until after she had poured the liquid into the mouth of the infant. The quantity swallowed was unknown. Two cases are reported (*Med. Times and Gaz.*, 1855, 1, p. 526) in which children were poisoned by swallowing a liniment of ammonia and oil. In one, an infant, death occurred speedily, probably from swelling and closure of the air-passages, thus leading to suffocation. In the other case, death took place on the following morning. Considering the pungent taste of ammonia, it is remarkable that an infant could have had the power of swallowing nearly two ounces of strong ammonia liniment. It had been poured down its throat by another child of five years of age. A strong solution of ammonia has been maliciously used for throwing on the person. It must be regarded as a corrosive liquid, capable of producing serious injury. The editor has seen several cases of severe injury resulting from the accidental spilling of a strong solution of ammonia on the person.

In the *B. M. J.*, 2, 1898, p. 1256, a fatal case is reported by K. Monro. The symptoms were those of capillary bronchitis, and a false membrane was found in the lungs almost to the alveoli. Ammonia fumes proved fatal to an old chronic bronchitic, who was using it for cleaning purposes (*Lancet*, 1, 1899, p. 1330).

GROUP 2.—POISONING BY THE METALLIC ELEMENTS AND BY THEIR SALTS.

The very slightest consideration of this group will show at once that it has nothing to recommend it as a group except what may be termed an "index" arrangement, or a principle of origin. Hydrocyanic acid should, for instance, be excluded if we adhere strictly to our title, while cyanide of potassium, the action of which is identical with that of the acid, must be included. What again except metallic origin is the connection between potassium bromide and iodide, with their skin eruptions and slight toxicity, on the one hand, with, say, arsenic and the arsenates and their irritant action, or with perchloride of mercury or antimony and its salts, on the other? It must be at once admitted that the group is a purely artificial one; and not only so, but any serial arrangement of the metals themselves is, from a toxicological point of view, arbitrary, and one only follows the commonly received chemical grouping of the metals for convenience, though it is possible that, just as chemistry has grouped the metals by their affinities and likenesses in forming salts, so it may some day be discovered that the metals ultimately poison by these affinities for the tissues in similar groups. For instance, antimony and arsenic both show some tendency to produce fatty degeneration, and their nearest ally in this as in a chemical series is the non-metallic element phosphorus.

We shall take them in the following order:—

Potassium salts, of which the following have been reported to give rise to toxic effects, viz.: the nitrate, sulphate, iodide, bromide, chlorate, permanganate, alum.

Sodium salts, only two of which, viz. borax and the iodide, are reported to have caused death.

Silver salts, the nitrate.

Barium salts, the chloride.

Magnesium salts, the sulphate.

Zinc salts, the sulphate and the chloride (Burnet's fluid).

Mercury and its salts, of which a large number have caused death.

Copper salts, also brass, an alloy of zinc and copper.

Gold salts, the chloride.

Thallium preparations.

Tin salts, the chloride.

Lead and its salts, practically all of which have caused trouble; also type metal (antimony and lead).

Arsenic and its salts. For gaseous arsenic, *vide* "Poisoning by Gases," Group 4.

Antimony and its salts, the chloride and the potassio-tartrate.

Bismuth salts.

Osmium tetroxide.

Chromium, as chromic acid and bichromate of potassium.

Iron salts.

Nickel and cobalt.

Uranium salts.

POTASSIUM NITRATE (KNO_3), NITRE, OR SALTPETRE.

Source and Method of Occurrence.—The salt is commonly used in medicine and is an ordinary commercial substance. Cases of poisoning by it are very rare and invariably accidental. "Warner's Safe Cure" is essentially a solution of nitrate of potassium.

Toxicity and Fatal Dose.—The degree of toxicity is very feeble. There seems to be no recorded fatal case from a dose less than an ounce. The official dose is five to twenty grains.

Duration.—The symptoms appear within about half an hour of swallowing the substance, and cases are recorded of death in two and in three hours.

Symptoms.—From the recorded cases these would seem to consist of pain in the stomach, soon followed by collapse (effect of absorption); vomiting and purging may occur, and if so they are rather favourable symptoms.

Treatment.—Must be directed to emptying the stomach by the stomach pump or by an emetic: there is no direct antidote. Beyond this, *vide* pp. 334 *et seq.* for general treatment.

Post-mortem Appearances.—In one case the stomach was found highly inflamed, and the membrane detached in various parts. Near the pylorus the inflammation had a gangrenous character. A large quantity of bloody liquid was found in the stomach. In another case, which proved fatal in sixty hours, where an ounce and a half of nitre had been taken, a small perforation was found in the stomach. In another, on examining the body, a bloody mucus was found in the stomach, the lining membrane was of a brownish-red colour, generally inflamed, and in parts detached from the coat beneath. None of the poison could be detected in the stomach; but its nature was clearly established from the analysis of a portion left in the vessel which had contained the draught.

Analysis.—For the chemical properties and method of detecting this salt, see pp. 383 and 408, "Tests for Potash."

Cases.—A case is reported by Orfila in which a lady swallowed, by mistake for another salt, an ounce of saltpetre. In a quarter of an hour there was vomiting and purging, the muscles of the face were convulsed, the pulse was weak, the respiration difficult, the limbs cold, and there was a sense of burning heat and severe pain at the pit of the stomach. She died in *three hours*. Geoghegan met with the following case:—A man took from an ounce to an ounce and a half of nitre by mistake for Epsom salts. Severe pain in the abdomen followed, with violent vomiting, but no purging so far as could be ascertained. He died in about *two hours* after taking the salt. Fuller had a case which proved fatal in 1863. A man swallowed an ounce of nitre, mixed with water, by mistake for Epsom salts. It produced vomiting, with severe pain, but no purging. There was coldness of the surface and lividity of the face. Death took place in three hours. On inspection the mucous membrane of the stomach was found highly inflamed, especially towards the middle of the greater curvature, where for several inches it resembled scarlet cloth. The pylorus and duodenum were of a deep crimson colour. The peritoneal surface was very vascular, especially over the stomach, the vessels having a vermilion red colour, as if they had been injected. The heart and lungs were healthy; the blood was fluid and more florid than natural. The other organs presented no unusual appearance. No analysis was made of the contents of the stomach, but that the nitre was the cause of death no doubt could be entertained, and a verdict was returned accordingly at the coroner's inquest.

In 1882, a farm labourer took an ounce of nitrate in mistake for Epsom salts at 7 a.m. When seen at 1.30 p.m., he was suffering from intense pain in the stomach of a burning character, with hot distressing eructations. The pain had come on immediately after taking the salt, with profuse perspiration. He felt sick, but did not vomit till 11 a.m. Vomiting was then free, and the ejected matters were of a coffee-ground colour, and apparently contained altered blood. The pulse was 56, and full and slow; the tongue moist, white, and tremulous. Micturition was frequent for the first three hours. Later in the day a liquid stool, of tarry appearance, was passed, and very offensive in odour. From this time he made a gradual recovery (*B. M. J.*, 1882, 1, p. 304). Two cases are reported of recovery after the administration of two ounces of nitre (*B. M. J.*, 1877, 2, p. 520; 1882, 1, p. 500).

SULPHATE OF POTASSIUM, SULPHATE OF POTASH, SAL POLYCHREEST, OR SAL DE DUOBUS.

Source and Method of Occurrence.—The salt is in use in medical practice, and the cases are always accidental in England, but according to Mowbray (*Med. Gaz.*, vol. 33, p. 54), sulphate of potassium is much employed in France as a popular abortive. He quotes several instances in which, in large doses, it produced severe symptoms (resembling those of irritant poisoning), and even death.

Toxicity and Fatal Dose.—The salt has feeble toxic properties. The official dose is ten to forty grains.

The question whether it is to be regarded as an irritant poisonous salt or not, was much debated among the members of the profession, in reference to a case which was tried at the Central Criminal Court in October, 1843 (*R.* v. *Haynes*).

The accused had given to the deceased, the night before her death, two ounces of sulphate of potassium, dissolved in water; and it was alleged that a fortnight previously to this she had taken, in divided doses, as much as a quarter of a pound of the salt. The woman thought that she was pregnant, but this was disproved by an examination of the body; and it was charged that the prisoner had given her the salt with the intention of causing a miscarriage. After the last dose, she was seized with sickness, and died within a very short time. The stomach was found empty, but highly inflamed; and there was blood effused on the brain. One medical witness referred death to the action of this salt as an irritant poison; the other to apoplexy, as an indirect result of the violent vomiting caused by it. The prisoner was acquitted of the charge of murder, but subsequently found guilty of administering the sulphate with intent to procure abortion.

Both of the witnesses admitted that, in small doses, the salt was innocent; but that in the dose of two ounces, it would produce dangerous effects. A case, somewhat similar in its details, was the subject of a trial at the Central Criminal Court in October, 1856 (*R.* v. *Galor*).

A married woman, the wife of the prisoner, under the belief that she was pregnant, took a large quantity of this salt, the prisoner having purchased two ounces, and handed it to her. It was taken with the design of procuring abortion, but it caused the death of the woman under symptoms of severe irritation of the stomach and bowels. The deceased was not seen by a medical man while living, but she suffered from severe pain, vomiting, and purging; the vomited matter had a bilious colour. On inspection, the stomach and the upper portion of the small intestines were of a deep purple colour, as if from the action of some irritating substance. The stomach when opened showed marks of irritation, and its mucous coat was much congested. In this organ there was a spoonful of a thick slimy fluid, which contained a quantity of sulphate of potassium. The intestines contained twelve ounces of a thick white fluid, highly charged with mucus, and this when analysed yielded sulphate of potassium. There was no doubt that death had been caused by an overdose of this salt.

In the cases here related there is no question but that excessive doses were administered, but there is a principle with regard to saline purgatives (and indeed to other medicines) that it is as well to bear in mind, viz., that if they fail for any reason to effect their ostensible purpose of purging, they are liable to be absorbed and then to cause depressant effects upon organs with which the blood brings them in contact. This principle helps to explain many anomalous cases of recovery as well as of death after taking of all sorts of poisons.

In one case, two drachms acted powerfully; and in another, four drachms of the salt administered to a lady after her confinement, had all the effects of an irritant poison. These cases are the only instances in which it is publicly known to have proved fatal in England; and they show that substances, commonly regarded as innocent, may sometimes give rise to important questions in toxicology.

Duration.—A lady, about a week after her delivery, took, by the prescription of her medical attendant, about ten drachms of this salt in divided doses, as a laxative. After the first dose, she was seized with severe pain in the stomach, nausea, vomiting, purging, and cramps in the limbs. These symptoms were aggravated after each dose: she died in **two hours**. It was supposed that some poison had been taken by mistake; but that was not the case, and the question was, whether her death was or was not caused by sulphate of potassium. On an inspection of the body, the mucous membrane of the stomach and intestines was pale, except in the valvulæ conniventes (folds), in which it was reddened. In the stomach was a large quantity of a reddish-coloured liquid, which, on analysis, was found to contain only sulphate of potassium, and no trace of any other common irritant poison. The examiners referred death to sulphate of potassium taken in an unusually large dose, whereby it had acted as an irritant poison on a person whose constitution was already much debilitated ("Ann. d'Hyg.," April, 1842).

Symptoms.—Are those of an irritant, rapidly followed by the usual symptoms of depression and collapse; *vide* the narrated cases above.

Treatment.—Must be symptomatic: the stomach may be emptied if thought advisable.

Post-mortem Appearances.—Those common to most irritants, illustrated by these cases.

Analysis.—It is said that sulphate of potassium has in some cases caused vomiting and other serious symptoms, from its containing as impurity sulphate of zinc. This, if present, would be easily discovered by the appropriate tests. A more serious impurity has been detected in it by Bussy, namely, arsenate of potassium. He found this poison in a sample of sulphate, supplied by a wholesale house in Paris (*Pharm. Jour.*, 1872, p. 954). This impurity may be derived from arsenical sulphuric acid used in its manufacture. It would be well to test for arsenic any sample of sulphate which has caused great irritation (see "Arsenic"). Arsenic may thus find its way into all medicines in which sulphate of potassium is used, *e.g.*, compound colocynth pill, and compound powder of ipecacuanha.

Other impurities of a poisonous nature have been occasionally found in this salt. The reader will find a full account of these by Chevallier ("Ann. d'Hyg.," 1872, 2, 137).

Sulphate of potassium is easily identified. It is a dry hard salt, soluble in water, forming a neutral solution. This solution, if sufficiently concentrated, is precipitated both by tartaric acid and by platinic chloride, whereby potassium is indicated; and the presence of sulphuric acid is known by the action of a salt of barium (p. 376).

In Organic Liquids.—This salt, being insoluble in alcohol, may have the organic matter removed from it by treating the liquid containing it (previously concentrated) with alcohol; or the substance containing the salt may be evaporated to dryness and incinerated, when the undecomposed sulphate may be obtained by lixiviating the calcined residue with distilled water. Sulphate of potassium exists naturally in some animal fluids, but only in traces.

POTASSIUM IODIDE (KI).

Source and Method of Occurrence.—The salt is in constant use in medical practice, and misadventure is the only way in which cases occur.

Toxicity and Fatal Dose.—There is no standard for the toxicity of KI; the salt is pre-eminently an example of that class of substances against which certain people have an idiosyncrasy, and for which a large power of tolerance may be established by gradually increasing the dose. The editor has known as much as 300 grains per diem administered to a patient for some weeks without any unpleasant symptoms; on the other hand, death is recorded (*New York Jour. of Med.*, 1850) from as little as twenty-four grains. With such discordant evidence it is impossible to lay down any rules, except that children seem to be especially prone to be affected by it. Doses of five, nine and twelve grains are recorded below as causing dangerous symptoms. The Pharmacopœial dose is five to twenty grains.

Duration.—Symptoms of iodism rarely commence till the drug has been taken for some time, but exceptionally the coryzal symptoms may appear very rapidly, owing to idiosyncrasy. We know that the salt is absorbed very rapidly indeed.

Symptoms.—In the fatal case mentioned above, a pemphigoid eruption in nose, mouth, throat and larynx occurred, with bloodstained stools (Mann, "For. Med.," p. 487). In non-fatal cases the symptoms resemble an intense cold in the head as a rule, and occasionally a purpuric eruption, especially on the legs, has broken out.

A gentleman was ordered by his physician to take three grains of the iodide in a draught of peppermint-water three times a day. After the third dose he felt unwell, and an hour after the fourth dose he was attacked with a violent shivering fit, followed by headache, hot skin, intense thirst, quick and full pulse, with vomiting and purging. These symptoms were succeeded by great prostration of strength. In spite of treatment, the purging lasted several days. The effects of the medicine in this case were so violent, although only *twelve grains* had been taken, that there is little doubt, if the patient had taken another dose, he would have died (*Med. Gaz.*, September 3rd, 1841). In October, 1841, a case was reported by Erichsen to the University College Medical Society, in which alarming symptoms resulted from a dose of only *five grains* of iodide of potassium. There was great difficulty of breathing, discharge from the eyes and nostrils, inflamed conjunctivæ, and most of the violent symptoms of catarrh. The iodide was discontinued, and the patient recovered. Lawrie found that seven and a half grains of the iodide, in three doses, produced in an adult dryness and irritation of the throat, great difficulty in breathing, and other serious symptoms. In another instance, thirty grains, in divided doses, caused severe headache and secretion of tears. In two instances, wherein he had prescribed it medicinally in small doses, it was, in his opinion, the cause of death (*Med. Gaz.*, 26, p. 588).

Treatment.—The only treatment is to stop the administration of the drug or combine it with a little arsenic. Doubling the dose, which used to be recommended, is a very unsafe procedure; any other treatment must be purely symptomatic.

Post-mortem Appearances.—These have nothing whatever characteristic about them.

Analysis.—The iodide may be distinguished by its cubic crystals and by its solution producing a blue colour with starch on the addition of strong nitric acid. The salt gives a violet odour to flame, indicative of potassium, and yields purple vapour of iodine when treated with sulphuric acid and black oxide of manganese. The iodides of the heavy metals may be used as colour tests for corroboration.

Cases.—The editor is unable to find any recent case of fatal poisoning by the drug, but unpleasant symptoms arising from it are only too common in everyday medical practice; "intolerance to the drug" they are termed.

POTASSIUM BROMIDE (KBr).

Source and Method of Occurrence.—Like the iodide, this salt is in constant use in medicine, and cases occur from time to time in which its use gives rise to rashes on the skin, and these in turn do occasionally cause death by exhaustion, but the editor knows of no reported cases in which there has been an immediate fatal event except the two mentioned below.

Toxicity and Fatal Dose.—Precisely the same general remarks may be made on this salt as on the iodide, and in all probability there is the same large variation in dosage. At any rate, the editor has known many cases of 280 grains a day being taken with nothing but good results, and has known as little as ten grains given over a period of twelve hours produce very troublesome effects, and probably these are nothing like records in either direction. Children seem to be very prone to show toxic effects from small doses. The official dose is five to thirty grains.

Duration.—In the two fatal cases with which the editor is acquainted, sleep was procured after an ounce and a half had been given over a period of twelve hours, and the sleep terminated in death in the one case after eighteen hours, and in the other after about six hours. In the cases in which the rash causes death there is commonly a duration of the case of from five or six days to as long as three weeks, either to death or recovery.

Symptoms.—Commonly, if bromide cannot be tolerated, there is a certain amount of nausea and colic, but it is not possible to say much more of immediate symptoms. If a rash is to occur it generally appears within a few days of the commencement of taking the drug, though exceptionally after a long period of tolerance a rash may appear. A sort of mental hebetude is common in those who are taking the drug in large doses, though it may be difficult to separate this from a post-epileptic condition not due to the drug. In the fatal cases below there was such a quickening of the respiration as to lead to a suspicion of pneumonia, though none was present; this was preceded by progressive drowsiness, culminating in a deep sleep of an apparently normal character, except that the patient could not be roused.

Treatment.—But little can be said upon this from a toxicological point of view. The salt is very rapidly indeed absorbed from the stomach, and may, like the iodide, be distinguished in the saliva and urine within a few minutes of its entrance into the stomach, so that emetics and purgatives are useless. Alcohol, ammonia, hot coffee, and other rapidly acting stimulants may be tried, as also hypodermics of strychnine (one-thirtieth grain repeated in an hour), and if the patient lives five or six hours there is hope of recovery if the kidneys are sound.

In the ordinary medicinal cases the drug must of course be at once stopped and the rash treated on ordinary lines by boracic fomentations. For further treatment *vide* works on medicine.

Post-mortem Appearances.—None in any way characteristic were found by the editor in the case below, nor is it to be expected that there would be any from what is known of the action of the drug.

Analysis.—The contents of the stomach may be filtered or dialysed and the ordinary tests applied.

Cases.—A medical man, aged about 40, became addicted to the morphia habit, and to obtain a cure submitted himself to the bromide treatment, and took a drachm every hour for eight hours; he then fell asleep with very rapid breathing, and never woke again, but died in about six hours. A woman, æt. about 45, a chronic alcoholic, went through precisely the same experience, but lived about eighteen hours after taking one ounce and a half of the drug.

In the *Lancet* for April 4th, 1896, p. 939, is a report of an inquest held in Essex on a man who probably died from overdoses of bromide of potassium. Suffering from neuralgia, he had been in the habit of taking this salt in doses of from two to three drachms. The drug does not appear to have produced any of the usual symptoms of bromism, but may have caused the palpitation of the heart of which the deceased had frequently complained. During the night of March 23rd he felt very cold, gave two deep gasps, and almost immediately expired. The medical practitioner who was sent for stated at the inquest that he found the deceased quite dead, his mouth wide open, the eyes half closed, and the pupils somewhat dilated. A bottle containing the drug was on the table, and examination showed that it was pure bromide of potassium. The witness attributed death to failure of the heart's action caused by taking the bromide.

On the above case the *Lancet* remarks:—

"It proves in a marked manner the danger of taking any drug, however harmless it may be reputed to be, in large and repeated doses without the advice of a medical man. No doubt in this instance a medical attendant would have recognised the depressant action the salt was exerting upon the heart, and would have discontinued its use.

Even in the most modern works on therapeutics this danger is not mentioned, yet it is well known that all potassium salts cause 'depression, shown by diminished energy of contraction of the cardiac muscle, with final stoppage in diastole' (T. Lauder Brunton). As this bromide is constantly administered in large and repeated doses, the action of its basic constituent should always be borne in mind, and if signs of its depressant effect are observed its use should be abandoned, the bromide of some other base being selected if in other respects the action is beneficial. Many secret remedies for 'fits' contain this drug in large quantities, and it is evidently desirable that the public should be warned that their use is not unattended with danger."

Chlorate of Potash ($KClO_3$).

Source and Method of Occurrence.—The drug is freely used in medicine, and accidental cases occur from overdosage.

Toxicity and Fatal Dose.—The drug is not commonly to be regarded as a poison; the official dose is five to fifteen grains. Idiosyncrasy seems to have some influence, but carelessness in its administration is responsible for most cases. The smallest recorded fatal dose seems to be the following, by Brouardel (*Jour. de Méd. et de Chir.*, December, 1881): A solution containing two drachms of the salt was given in divided doses every ten minutes to two children, the administration extending over a period of about three hours. The symptoms were those of gastro-intestinal irritation, with blueness of the surface, and collapse. Death took place within a short time. It seems to act by attacking the hæmoglobin and converting it into methæmoglobin (*vide* "Blood Tests").

Duration.—Death does not take place very rapidly, that is, not within several hours.

Symptoms.—A man æt. 18, took about an ounce of this salt in water in two doses at intervals of half an hour. In a short time he became faint and thirsty, and in two hours he vomited. There was pain in the region of the stomach, headache, constipation, and anorexia. The skin was pale, and the ears and extremities blue. Rigors and slight jaundice appeared. The pulse was good and regular. Tenderness over the regions of the stomach and kidneys supervened. The urine was very scanty, contained albumen and disorganised blood corpuscles, and eventually was suppressed; and death occurred on the sixth day. After death, fluid was found in the pleural and pericardial cavities and œdema of the lungs. The whole alimentary canal was inflamed and eroded in patches. The kidneys, liver, and spleen were enlarged (Landerer, in *Deutsch. Arch. f. Klin. Med.*, 1890, xlvii. p. 103).

Hæmaturia is a frequent symptom, or perhaps, rather, hæmoglobinuria, in the ordinary clinical cases of unpleasant symptoms.

Treatment.—There is nothing to be done but general means to combat depression—unless it be thought worth while to wash out the stomach.

Post-mortem Appearances.—There is nothing special about these, unless it be the methæmoglobin to be found by the spectroscope (*vide* also case above).

Analysis.—The salt may be recognised by the ordinary tests used in inorganic chemistry, also by the bleaching of indigo on adding a few drops of strong sulphuric acid to a solution of indigo mixed with the chlorate.

Case.—The following occurred a few years ago at Morecambe:—An inquest was held at Morecambe on the body of Eric Spencer, æt. 2. The uncle of the child deposed that it was very fond of sweets, and to cure it of the taste he purchased some chlorate of potash tabloids on Saturday afternoon while on a holiday at Morecambe, giving him about six, and two hours afterwards a similar number. Witness had occasionally used the tabloids, having himself taken a dozen or twenty in a day. On Saturday evening the child became ill. Dr. Benson stated that the child died from poisoning. It had been a great error of judgment to give the child so many tabloids, as ten grains would be fatal for a child of two years, and each tabloid should contain from four to five grains of chlorate of potash. It acted as a gastro-intestinal irritant, and an overdose was calculated to produce death in two hours at the most. The coroner, quoting from an authority, said that the smallest fatal dose recorded was forty to forty-five grains given to a child of three. He hoped the case would act as a warning to people. The jury returned a verdict of "Accidental death from poison. unconsciously administered."

The editor is unable to verify or refute the conclusions of the doctor or of the coroner, but would be distinctly of opinion that ten grains would not be likely to be fatal if given to any child, though in a child of three or under they might produce unpleasant symptoms.

Potassium Permanganate ($KMnO_4$).

Source and Method of Occurrence.—The drug is official, and its dose is given as one to three grains. It occurs in small crystalline masses of a dark reddish-purple colour. It is soluble to the extent of 1 in 20 of water, forming a magenta-red solution. "Condy's Fluid" is a solution of the sodium salt. $KMnO_4$ is usually considered a very safe disinfectant, but at least one fatal case of poisoning by it is on record.

Toxicity and Fatal Dose.—As above stated, the toxicity of this substance is not great (it is now used freely as an antidote to other poisons, particularly morphia and snake venom). In the case recorded below a "handful" of the crystals proved fatal.

Duration.—In the case below death ensued thirty-five minutes after taking the poison.

Symptoms.—Dr. Hawthorne (*Lancet*, 2, 1899, p. 1467) thus reports them in a case under his care:—

"On September 2nd I received a hurried message to visit a married woman, aged thirty-six years. On arrival I found my patient to be suffering from almost continuous vomiting, unable to retain either solids or fluids; there were great pain and tenderness on pressure over the whole extent of the abdomen, excessive thirst, congestion of the fauces, and slight difficulty in swallowing; the temperature was 100° Fahr., the tongue was moist and pale, and the pulse was 120 per minute. There was an anxious expression of the countenance, also sleeplessness. The urine was scanty and high-coloured; the bowels were regular. There was slight tympanitic distension, and the legs were drawn up. The weight of the bedclothes caused pain over the abdomen. On questioning her, I learnt that she had been in good health up to the previous day, when she was attacked with vomiting and pains in the stomach, which kept increasing. I could elicit no information as regards indiscretion in food or drink, but in a casual manner she stated that she had been taking pills three or four times daily, procured from a chemist, with the object of bringing on her menses, which had not appeared for two months, and that these pills, when broken and put in water before swallowing, turned the water the colour of 'Condy's Fluid.' I took away one of the pills for examination, and found it to be of large size, ovoid in shape, coated with sandarach, and should say it would contain about two grains of permanganate of potassium. She finally recovered in a week's time. The amount of permanganate of potassium taken by the patient during a period of four days was twenty-two grains."

Treatment.—The stomach should be washed out, and general measures adopted to combat shock and depression (*vide* p. 334).

Post-mortem Appearances.—In the case quoted below the mucous membrane of mouth, tongue, fauces, and gullet was destroyed and charred; the non-destroyed parts were intensely congested. The larynx and trachea were inflamed, and œdema of glottis was present. The stomach was filled with dark, grumous matter, and the greater part of its mucous membrane was destroyed and blackened; similar changes were found in the duodenum; intestines otherwise healthy; other organs in a natural condition except for old alcoholic changes (*Lancet*, 2, 1899, p. 411).

It must not be assumed that these appearances nor anything like them will always be found, as no doubt the drug could kill by its effects after absorption in doses much less than "a handful." The above merely show that it can be a very severe irritant, nearly a corrosive.

Analysis.—When unaltered, the colour of a solution of permanganate is very distinctive; a solution supposed to contain it may be filtered and the ordinary tests for manganese applied.

Case.—M. C., æt. 47, a heavy drinker, was drunk on February 26th, 1899, and took in some beer a handful of the crystals. On arrival at St. Thomas's Hospital the lips and mouth were darkly stained; shock was marked, she was pale, the skin was very dry, pulse rapid but moderately strong. Slight signs of dyspnœa soon came on; two or three minutes after admission the pulse could not be felt, and respiration soon ceased.

ALUM.

The double sulphate of aluminium and potash, known as alum, is in common use as an astringent, but it acts as an irritant poison when given in large doses. Tardieu, who gives the details of two cases of fatal poisoning by alum ("L'Empoisonnement," p. 218), is of opinion that from half an ounce to an ounce of the salt is a fatal dose for an adult. In 1888 Bull communicated to Sir Thos. Stevenson a case in which a diphtheritic child, æt. three years, died from the effects of a teaspoonful of alum given in syrup as an emetic. The child did not vomit, and died shortly after. The mucous membrane of the stomach was red and velvety, as if from the effects of a powerful irritant.

SODIUM BORATE, OR BORAX.

Source and Method of Occurrence.—Borax, which is the sodium salt of boracic acid, and the acid itself, are used very largely both as mild antiseptics in surgery and also as food preservatives; it is therefore right that unpleasant symptoms arising from their use should be noted here. Two fatal cases have indeed been reported in the *B. M. J.*, Epit., 2, 1901, par. 401, which runs as follows (the editor has been unable to obtain further particulars):—

Rinehart (*Therap. Gaz.*, October 15th, 1901) records two rare cases of the symptoms of poisoning with boracic acid, and points out the importance of the subject in view of the use of boracic acid as a food preservative and the general belief in its supposed innocuousness. In two fatal cases cited by Wood (work on Therapeutics), of Philadelphia, the symptoms were nausea and vomiting, hiccough, an erythematous skin eruption, fall of temperature, and fatal collapse. The mind remained clear. The text-book dose of boracic acid—ten grains every four or five hours—is regarded as too large and prone to induce symptoms of cardiac enfeeblement and collapse. Case 1.—Man, aged thirty-eight years, had posterior urethritis treated with weak $AgNO_3$ solution locally, and five-grain doses of boracic acid by the mouth every four hours. Two days later there followed extreme weakness, and an erythematous rash beset with papules and vesicles developed on the back of the hands and between the fingers. Pulse weak, but not accelerated. The symptoms subsided slowly upon withdrawal of the boracic acid, and reappeared on resuming the drug. The case would probably have ended fatally if the cause of this alarming collapse had escaped detection. Case 2.—Man, aged fifty years, had a suprapubic lithotomy performed on him, and the bladder washed out daily with saturated solution of boracic acid, and five grains of the drug given by the mouth every four hours. Ten days after the operation there appeared an erythematous rash about the wound and spreading over the hypogastrium. Scales and crusts formed on the rash, and the skin thus affected became thickened and infiltrated as in eczema. On discontinuing the boracic acid the eruption slowly disappeared, and on resuming the drug it reappeared in two days. The drug was slowly eliminated from the system, and hence the rash could be made to reappear with ease. Albuminuria and weakness became prominent symptoms during the appearance of the rash in this patient; the pulse was feeble, nausea was present, and at the height of the eruption the temperature rose one or two degrees above the normal. Rinehart concludes that in view of the above facts the use of boracic acid as a food preservative should be discontinued, "as the poisonous effects of any quantity sufficient to preserve food would appear to be proven."

This article brought forth the following rejoinder from Dr. Oscar Liebreich (Pharm. Inst., Berlin):—

Under the heading "Poisoning by Boracic Acid" there appeared in the "Epitome" of the *B. M. J.*, December 7th, 1901, par. 401, an abridged account of several cases reported by G. F. Rinehart (*Therap. Gaz.*, Philadelphia, No. 10). Unfortunately, the abridged account leaves out some very important data, so that it is impossible for the reader to form a correct opinion of the cases.

Mr. Rinehart had two cases; the first, a man aged thirty-eight, with posterior urethritis, was given five-grain doses of boracic acid by the mouth every four hours; the second, a man of fifty, received a similar dose by the mouth every four hours, and also had his bladder washed out daily with a concentrated solution of boracic acid. In both cases serious after-effects were observed.

I would here remark that the first and second cases are more alike in character than would appear from the account in the "Epitome." For the original article states that in the first case also the bladder was washed out periodically with a concentrated solution of boracic acid. Now, it has never been denied that washing out body cavities and the bladder with very large doses of boracic acid in cases like the above, that is, where the epithelium is not in a normal condition, may entail serious consequences. It must be borne in mind that a concentrated solution of boracic acid is a 3 per cent. solution, and that one or two litres of it are often employed, so that about sixty grams, that is, about two ounces of boracic acid pass through the bladder, which thus has occasion to absorb a far larger amount of boracic acid than is ever given by the mouth. In the above cases, therefore, the five grains given per os every four hours are so small an amount comparatively that they cannot be considered as playing any part in the dangerous effects observed.

The account in the "Epitome" further speaks of two fatal cases of boracic acid poisoning observed by C. H. Wood; but it omits the statement in both those cases too—as in the first two—there was washing out with concentrated solution of a lumbar abscess in one case and a pleuritic cavity in the other. The account in the "Epitome" also omits two important remarks of Wood. He says:—"They (boracic acids and salts) have a very feeble effect upon the animal system," and further, that his experiments show "that enormous doses depressed the spinal centre of the frog," that is, of course, in the shape of subcutaneous injections.

In conclusion, I see no reason to modify my statement in my pamphlet on "Borax and Boracic Acid" (J. and A. Churchill, London, 1899), namely, that there are no cases on record of poisoning from the internal use of borax and boracic acid in doses such as are customary for the preservation of food, and even in far greater doses. But I have never denied that excessive absorption from body cavities may cause dangerous symptoms. But Mr. Rinehart is wrong in considering these symptoms to have any relation to, or connection with, the doses used in the preservation of food. Such reasoning would lead us to discard substances such as common salt and saltpetre, which even in weak solutions may cause dangerous accidents in the treatment of wounds.

After considerable search through medical journals, the editor has not found any fatal cases reported, but in the *Lancet*, 1, 1899, p. 23, is a case of dermatitis and other toxic effects of boric acid, reported by Dr. R. B. Wild, and in the *B. M. J.*, 1, 1899, p. 17, Dr. Sophia Grumpelt records the following:—

A short time ago, while attending a lady suffering from long-standing inflammation of the bowels, I ordered irrigations of boracic acid twice daily—a tablespoonful to a pint of warm water. The result was most satisfactory as regards the disease, but after three or four injections she began to complain of headache, slight nausea, and intense dryness of the skin. On discontinuing the use of the boracic acid injections the symptoms ceased, to commence again with the resumption of irrigation. They ceased only when the disease was so far cured that we were able to use a solution of half the strength once daily. This is the first case I have met in which boracic acid caused unpleasant symptoms, and I have used it freely for children.

The official dose of borax is five to twenty grains, and the evidence seems distinctly to point to this as safe.

Into the question of how far the addition of borax or the acid to food stuffs should be allowed it is impossible to enter here. The reader is referred to Liebreich's book (*supra*).

For a further case *vide Lancet*, 1, 1909, p. 1345.

Here it was alleged that five grains of borax to the pint caused diarrhœa, loss of appetite and weight, in a very young child. The evidence that these symptoms were due to the borax seems inconclusive, but it was sufficiently conclusive for the trial, and damages were awarded against those responsible for its introduction.

SODIUM IODIDE (NaI).

The following is taken from *B. M. J.*, Epit., 2, 1899, No. 148. Considering the slight toxicity of the salt, it would seem that the syphilis had more to do with death than the iodide:—

Franz (*Wien. Klin. Woch.*, No. 23, 1899) reports a fatal case of iodine poisoning. The patient, a man aged seventy, suffered from arterio-sclerosis, chronic interstitial nephritis, and hypertrophy of the left ventricle. Ten years before he contracted severe syphilis. On December 3rd and 4th he was given fifteen grains of sodium iodide. This was followed by iodism and iodine acne. On the same day appeared sub-conjunctival petechiæ, swelling of the mucous membrane of the nose and throat, dyspnœa and swelling of both testicles. On December 7th the nares ulcerated; the urine contained albumen, hyaline and granular casts. No iodine was found in the urine. On December 10th there occurred inflammatory infiltrations in the skin of the face and trunk; a phagedænic ulcer formed on the lower lip; the skin of the trunk and extremities was covered with small abscesses and vesicles containing turbid yellowish-green serum. This condition was followed by double hydrothorax, pulmonary œdema, and death. At the necropsy the following changes were found: pemphigus of the skin and mucous membrane of the œsophagus, chronic interstitial nephritis, hypertrophy and dilatation of the heart, sero-fibrinous pericarditis, double hydrothorax, œdema of brain and lungs, chronic perisplenitis, and commencing cirrhosis of the liver. The explanation of the case is that owing to the diseased state of the kidneys the iodine was not eliminated, and the amount retained was sufficient to cause death in such a broken-down subject.

Poisoning by Zinc Salts.

Source and Method of Occurrence.—The sulphate of zinc is employed to some extent in medicine as a safe and reliable emetic; dose, ten to thirty grains; also as tonic, dose, one to three grains.

Tardieu and Roussin have published a case of criminal poisoning by sulphate of zinc administered in soup. A woman, æt. 60, died in three days under the usual symptoms of irritant poisoning (gastro-enteritis). Zinc was detected in the coats of the stomach and intestines, as well as in the spleen and liver ("Ann. d'Hyg.," 1871).

A case is reported, in which it is supposed that the sulphate destroyed life by its slow or chronic effects (*Lancet*, 1859, 2, p. 210).

The chloride practically only occurs as a disinfectant under the name of "Burnett's Fluid," which is a highly concentrated solution of the pure, or sometimes impure, chloride of the metal, containing about 220 grains of the salt per fluid ounce; it has been taken by accident in several cases, and in one instance was supposed to have been criminally administered as a poison.

The oxide is largely used in medicine in the form of ointment, but no case is recorded of poisoning by it.

For an account of wholesale poisoning by drinking water impregnated with a zinc salt, probably the carbonate, *vide B. M. J.*, 2, 1901, p. 615.

In 1891 three deaths from zinc salts were recorded in England and Wales, but none in 1901.

Toxicity and Fatal Dose.—Neither the sulphate nor the oxide of zinc can be regarded as powerful irritants, although they are usually described as poisons.

Luff reports ("For. Med.") that death has occurred in an adult after taking an ounce and a half of the sulphate, but he gives no reference.

In one case a lady recovered after taking sixty-seven grains (*Lancet*, 1856, 1, p. 540). In another, which occurred in 1872, communicated by Mackintosh, a man, æt. 20, recovered in a few days after taking an ounce of sulphate of zinc by mistake for Epsom salts, to which it closely approximates in appearance. There was early vomiting and purging of a most violent kind, with great prostration of strength. The greater part of this large dose was no doubt thus carried out of the body.

In cases of epilepsy, sulphate of zinc has been given in doses of forty grains three times a day, first commencing with small doses. As a rule no ill effects follow, and none of the usual symptoms of irritation are observed. With respect to *oxide of zinc*, it has been prescribed in large doses without injury to health. An epileptic took as much as one pound in seven months, the largest quantity taken in one day being seventy grains. Although he did not suffer from the remedy, the disease was not cured (*Lancet*, 1862, 1, p. 224).

The chloride, or at least "Burnett's Fluid," is much more toxic, but the exact doses of the chloride are not available. Luff (*loc. cit.*) says six grains have proved fatal: there can be no doubt but that the free acid is as responsible as the true salt, or more so, for the fatal event.

Duration.—In an acute case it is possible to believe that death might occur in three or four hours from exhaustion if the victim were already debilitated by disease, but the shortest recorded is **two hours** (*vide* below). If death does not thus take place recovery is usually rapid except in the case of the chloride, which produces undoubtedly gross organic change in the mucous membrane of the stomach as well as a simple acute gastritis. The latter may pass off in a fortnight or so, but the former may lead to any or all of the ordinary results of a gastric ulcer, *i.e.* hæmorrhage, perforation or scarring, with blockage of the exit from the stomach, and to these no approximate limit can be assigned.

In one case, about two ounces of a solution containing only twelve grains of the chloride were swallowed. The patient immediately felt pain and nausea; vomiting followed, and she recovered, but suffered from some indisposition for three weeks. In a second case, a wine-glassful, equivalent to at least two hundred grains of solid chloride, was swallowed. The man instantly experienced a burning pain in the gullet, burning and griping pain in the stomach, great nausea, and coldness. Vomiting came on in two minutes; the legs were drawn up to the body; there was cold perspiration, with other signs of collapse. He recovered in sixteen days (ed. *Med. and Surg. J.*, 1848, p. 335).

In 1863 a girl took half a wineglassful of "Burnett's Fluid," and died in less than two hours.

Symptoms.—The symptoms produced by an overdose of sulphate of zinc, which is a powerful emetic, are pain in the abdomen and violent vomiting, coming on almost immediately, followed by severe purging; if it is the chloride which has been swallowed, there is often, but not invariably, a burning pain in the mouth and gullet as the poison is swallowed.

Cases show that a concentrated solution of the chloride has a strong corrosive action, destroying the membrane of the mouth, throat, gullet, and stomach. Judging, too, by other cases, it would appear possible that zinc may cause peculiar nerve symptoms after absorption. Thus in one case loss of voice was marked (? laryngitis), and in another, after the lapse of a fortnight, a train of nervous symptoms set in, indicated by a complete perversion of taste and smell. The patient recovered in about three months (*Lancet*, 1853, 2, p. 159).

Treatment.—White of eggs and milk should be given. Beyond this there is little antidotal treatment to be done, for vomiting occurs from the poison so freely that there is no necessity to empty the stomach. General measures to counteract shock and collapse must be adopted (*vide* p. 334).

Post-mortem Appearances.—These are not characteristic of zinc, but must be recorded as facts. They are the natural results of strong irritants, with slight corrosive power, and were probably more due to the free hydrochloric acid than the chloride of zinc.

In the case of an infant, aged fifteen months, which died from the effects of this poison, the lining membrane of the mouth and throat was white and opaque. The stomach was hard and leathery, containing a liquid like curds and whey. Its inner surface was corrugated, opaque, and tinged of a dark leathern hue. The lungs and kidneys were congested. The fluid of the stomach was found to contain chloride of zinc (*Med. Times*, July 13th, 1850, p. 47).

In a case, which proved fatal at Guy's Hospital in 1856, the coats of the stomach were excessively thickened, and had a leathery consistency. In another case, the stomach is described as being shrivelled up and ulcerated (*Pharm. Jour.*, January, 1867, p. 420). In Markham's case, the stomach was so constricted at the intestinal end by a cicatrix, that it would only admit a crow-quill. The pyloric opening was involved in this cicatrix, which was about one quarter of an inch wide. There was no other sign of disease in the body.

In one case, with the exception of the cardiac orifice, which was healthy, the whole of the mucous membrane of the stomach was of a deep red colour, thickened, and softened. This redness was uniformly intense, as far as that part of the fundus which lay in contact with the spleen; here the redness was deeper than elsewhere, and there was an ulcer of the size of a penny-piece, which had penetrated the coats of the stomach, but had been prevented from perforating, partly by the spleen, which formed the floor of the ulcer, partly by adhesions which passed from the spleen to the stomach. There was also congestion along the whole length of the intestinal canal. (Other cases will be found reported in the *Lancet*, 1864, 1, p. 35; and 2, p. 267.)

Analysis.—The sulphate is seen in white prismatic crystals, closely resembling in appearance Epsom salts and oxalic acid; from oxalic acid it is distinguished by remaining fixed when heated on platinum-foil; from Epsom salts, by tests applied to its solution. It is readily dissolved by water, this fluid taking up about one-third of its weight at ordinary temperatures. The solution has a slightly acid reaction, and the following tests may be applied to it for the detection of zinc. 1. *Ammonia* and potash give white precipitates, soluble in excess of the alkalies. 2. *Ferrocyanide of potassium*, a white precipitate. 3. *Sulphuretted hydrogen* and sulphide of ammonia, milky-white precipitates, provided the solution is *pure* and neutral, or nearly so. If the solution is very acid, sulphuretted hydrogen produces no effect whatever. 4. Zinc may be separated in the metallic state by placing in the solution a slip of magnesium (*vide* also p. 376.)

In Organic Liquids.—If the sulphate is dissolved, and the solution is not too acid, we may pass into it a current of sulphuretted hydrogen gas; the presence of zinc is immediately indicated by a milky-white precipitate; the sulphide may be collected and decomposed by boiling it with hydrochloric acid. The solution may be then tested for zinc. This compound being frequently employed as an emetic, may be innocently present in an organic liquid, or in the contents of the stomach. Sulphate of zinc has been occasionally fraudulently added to bread (Horn's *Vierteljahrsschr.*, 1870, 1, 323).

Of the Chloride.—The chlorine may be detected by nitrate of silver—the zinc by the tests already described. If a portion of the diluted solution is placed in a platinum capsule, and the platinum touched with magnesium, the zinc is immediately obtained in the metallic state.

The following is a useful and delicate test for compounds of this metal: Evaporate a small portion of the suspected solution to dryness. Heat a little of the dry residue on platinum wire in the oxidising flame. A zinc residue will be yellow when hot and white when cold. Moisten with cobalt nitrate and heat again: a zinc residue will now turn green. Zinc can be detected in the *tissues* only by incineration at a low temperature, and an examination of the ash. The chloride is, however, sometimes used for the preservation of the dead body. This might account for its occasional presence.

Cases.—The following is reported by Dr. Mackintosh (*B. M. J.*, 2, 1900, p. 1706). The packet contained one ounce of the sulphate, but it is possible that she swallowed two ounces:—

> I was called to see A. C., a widow, aged fifty-three years, at about 5 p.m. on July 5th, 1900. She was said to have swallowed a large packet of sulphate of zinc at some time between 1 and 3 p.m. She was suffering from severe pain in the stomach and bowels, paleness of the countenance, coldness of the limbs, irregular pulse, and cold sweats, with purging, but had only vomited about a teaspoonful. I administered a large amount of carbonate of soda diluted freely with tepid water. Copious vomiting of a white fluid ensued (showing presence of carbonate of zinc). After which I directed that she should be frequently given white of egg and milk, and later on, when signs of collapse appeared, whisky with the latter. I injected ½ gr. of morphine for the pain, and afterwards gave 1 gr. opium tablets at intervals. I saw her again at 7 and 9 p.m. At the latter time she seemed easier. When visited at 9.20 a.m. on July 6th she was almost pulseless and collapsed. Every effort was made to revive her, but she died in a state of collapse at about 10.30 a.m., about twenty hours after taking the poison. *Necropsy* made forty-eight hours after death.
>
> *Externally.*—The body was well nourished: post-mortem lividity slight, decomposition rapid. *Condition of the Head and Viscera.*—The membranes of the brain were congested, and there was a large amount of blood in the sinuses. The brain weighed 2¾ lbs.; the arteries at the base were congested, and there was a considerable amount of serous fluid in the left ventricle, and a little in the right. *Condition of Thorax and Viscera.*—The pleura was normal and non-adherent. Both lungs were engorged with dark blood. Heart normal, although slightly hypertrophied. *Condition of Abdomen and Viscera.*—The stomach contained partially digested egg and milk. The mucous membrane lining it showed patches of intense inflammation, but this was much more marked in the small intestines, which were inflamed throughout. The inflammation in the large intestine was, again, of a patchy character. So vivid was the congestion of the small intestines that it was plainly visible from the outside before they were slit up. Liver, 51 ozs., anæmic but otherwise normal. Spleen, soft and congested. Left kidney, 4½ ozs., and fatty; right, 4 ozs., normal.

Lancet, 1, 1909, p. 1137, reports a case in which a girl, æt. 13, died from zinc poisoning in which the metal was taken in food prepared in cooking pans coated with an alloy containing zinc.

MAGNESIUM SALTS.

Source and Method of Occurrence.—The sulphate and the two carbonates are used in medicine as the commonest and safest of the saline aperients, but it is generally to be noticed that if these ordinary saline purgatives do not exert their expected action of purgation they are likely to give rise to toxic symptoms, for they exert a deleterious action on the heart after absorption, probably by reason of the metallic element, in a manner similar to, but less powerful than, that in which barium is known to act. For a case of this nature, happily not fatal, *vide Lancet*, 2, 1896, p. 461.

Toxicity and Fatal Dose.—It is somewhat difficult from a toxicological point of view to speak of a fatal dose or even of toxicity, for the former as recorded is **one ounce**, and yet this is a perfectly natural and even proper dose to be administered to an adult.

Duration.—Some hours generally elapse between the taking of the material and the fatal event, but the symptoms themselves commence in about half an hour or less. Death has followed in eighty minutes after taking four ounces (*Lancet*, 1891).

Symptoms.—Vomiting occasionally occurs, with some pain in the stomach. Cyanosis, stupor, and tetanic spasms were observed in a case recorded by Headley Neale (*vide Pharm. Jour.*, September 12th, 1896, p. 235) in a lad æt. 15 who had taken an ounce. In the *Lancet*, 1891, is recorded a case in which with local stomach pain a choking feeling occurred, rapidly followed by collapse.

Post-mortem Appearances.—In a case recorded by Luff ("For. Med.") there were no special appearances in the stomach noticeable.

Analysis.—After filtration of the vomit or stomach contents the ordinary tests for magnesium may be applied to the filtrate.

Cases are rare, but the *B. M. J.* (1891, 2, pp. 490 and 574) records two fatal cases of poisoning by Epsom salts. In one of these cases one ounce only of the substance was taken—an ordinary large dose.

Chas. Fraser, M.D., in the *Lancet*, 1, 1909, p. 1174, records a non-fatal case in a boy three and a half years of age from a "heaped-up teaspoonful." In the same article he refers to the fact that from 1841 to 1896 he could only find records of six cases, which he then proceeds to describe.

Poisoning by Silver Salts.

Source and Method of Occurrence.—The nitrate is the only salt that has caused symptoms of poisoning, and that usually by accidental slipping when the throat is being painted with "silver stick." It is used as a pure preparation and also in a form known as "mitigated silver."

Toxicity and Fatal Dose.—The actual fatal toxicity is not very great, but the irritation caused may be very severe.

In 1861 a woman, æt. 51, died in three days from the effects of taking a six-ounce mixture containing fifty grains of nitrate of silver (lunar caustic) given in divided doses.

Duration.—The case below died in six hours, which is the shortest on record.

Symptoms.—Pain in stomach, vomiting and purging come on rapidly as in most other irritants.

Before bromide of potassium was used for epilepsy, silver used to be given, and in many cases produced a peculiar discoloration of the skin, but such cases are now practically unknown ; but it may be that some day a civil action for damages may be brought, if it is alleged or proved that a preparation for the hair contains the salt, and a discoloration of the skin has followed. There is no means known by which the colour can be removed.

Treatment.—Common salt is the best antidote, forming as it does a chloride of silver which is insoluble in acids, but requires evacuation by emesis or purging.

Post-mortem Appearances.—Only characteristic of an irritant, inflammation of stomach and intestines.

Cases.—A well-marked case of poisoning with this substance occurred to Scattergood. A portion of a stick of lunar caustic dropped down the throat of a child aged fifteen months. In spite of treatment, the child died in six hours in violent convulsions (*B. M. J.*, 1871, 1, p. 527, and *Amer. Jour. Med. Sci.*, July, 1871, p. 287).

Analysis.—Luff gives the four following tests for silver:—

1. Hydrochloric acid gives a white curdy precipitate of silver chloride, insoluble in nitric acid, but soluble in solution of ammonia.
2. Potassium chromate gives in neutral solutions a red precipitate of silver chromate.
3. Lime-water produces a brown precipitate of silver oxide.
4. Sodium phosphate gives a yellow precipitate of silver phosphate.

Poisoning by Barium Salts.

Source and Method of Occurrence.—The salts of barium are commercial articles. The recorded cases have been due to accident and to suicide. The chloride and carbonate enter into some rat poisons (Mann). The salts are used in sizing cotton.

Toxicity and Fatal Dose.—The salts of barium are distinctly to be looked upon as poisons; they have not only a local irritant action, but it is also asserted that barium salts are similar in their action to digitalis, that they are cardiac poisons, the ventricles of the heart after death being found rigidly contracted.

The smallest quantity of a soluble barium salt that has produced death is one hundred grains in an adult; one teaspoonful (Mann) of the powdered chloride has caused death.

Duration.—This varies from one hour to seven days.

Symptoms.—They usually consist of great thirst, excessive vomiting and purging, convulsions, dilated pupils, and paralysis. The post-mortem appearances are variable, except that intense inflammation of the lower bowel (rectum) is constantly observed in fatal cases. *Vide* also cases below.

Treatment and Antidotes.—An ounce of sulphate of soda or Glauber's salts dissolved in a tumbler of water should be administered, with the object of converting the soluble barium salt into the insoluble sulphate of barium. The stomach-pump or tube should be afterwards employed, and the stomach thoroughly washed out. The after-treatment should be directed to overcoming the depressant and convulsant action of the poison. The patient should be wrapped in warm blankets, and hot-water bottles applied to the feet; brandy should be given either by the mouth, rectum, or hypodermically, to counteract collapse. If much pain persist, hypodermic injections of morphine should be employed (Luff).

Post-mortem Appearances.—In one case at the post-mortem examination, made fifty-six hours after death, the stomach was found much ecchymosed from the fundus to the lesser curvature. The ecchymoses were in large patches over the fundus, in smaller patches towards the middle, and in still smaller patches at the pyloric portion of the organ. The intervening membrane was covered with a little mucus. Particles of the poison were found imbedded in the mucous membrane. The peritoneal aspect of the stomach was of a pale red tint. There were numerous ecchymosed patches in the duodenum. Two grains of carbonate of barium were extracted from the stomach. The quantity taken could not be ascertained. Traces of barium were also detected in the liver ("Archiv. der Pharm.," [3] 4, 1574, p. 426).

Mann (*loc. cit.*) states that in one case the stomach was perforated.

The editor cannot find that there is anything special to barium poisoning to be found in the post-mortem except the metal itself by analysis.

Analysis.—*Chloride of Barium* crystallises in thin plates: it is soluble in water. 1. The solution yields an insoluble white precipitate with sulphuric acid or an alkaline sulphate. This precipitate is insoluble in nitric acid. 2. The powdered salt, burnt on platinum wire in a smokeless flame, imparts to it a greenish-yellow colour. 3. Chlorine may be detected by a solution of nitrate of silver (*vide* also p. 387).

Carbonate of Barium is a white insoluble powder. It is entirely dissolved with effervescence (carbonic acid) by diluted hydrochloric acid. This solution on evaporation yields crystalline plates of chloride of barium, which may be detected by the processes above mentioned.

Note to be added to the Tests for Barium.—It must be borne in mind that lead solutions also give a white precipitate with sulphuric acid, and that copper compounds give a more intense green colour to flame. The presence of these two metals must therefore be excluded by showing that the suspected solution when slightly acidulated with dilute HCl gives no black precipitate with H_2S.

Cases.—A woman, æt. 33, took by mistake for Epsom salts less than a teaspoonful (one hundred grains) of the chloride. In half an hour there was a feeling of deadly sickness, with sharp burning pains in the stomach and bowels. Vomiting and purging set in violently, the purging being attended with straining. An hour and a half after she had taken the poison the following symptoms were observed: the face pale and anxious, eyes deeply sunk, surface cold, heart's action feeble, pulse scarcely perceptible, tongue natural and warm, loss of muscular power, sensation and intelligence not affected, pupils natural. Fluids taken were instantly rejected with a ropy mucus. There was pain in the stomach, singing in the ears, twitching of the face, and twisting of the legs and arms. In eight hours and a half the symptoms had abated, but in about fourteen hours the purging had returned, and the symptoms were much worse. There was a loss of voluntary muscular power. The breathing was slow and laboured, and indicated effusion in the bronchial tubes, but the woman was sensible. An hour later she was convulsed, and these convulsions continued in paroxysms for two hours, when she died, seventeen hours after taking the poison. During the fits she had several watery evacuations, and consciousness was lost. There was no post-mortem examination (*Lancet*, 1859, 1, p. 211).

A case of poisoning by this salt is reported by Wildberg. The symptoms were those of irritation, combined with an affection of the brain and nervous system. Giddiness, convulsions, and paralysis were remarked among them. In the case referred to, half an ounce proved fatal in two hours: in another instance one ounce, taken by mistake for Glauber's salts, destroyed life in *an hour*. In small doses, even, the chloride has been observed to affect the system powerfully. Orfila found that chloride of barium was absorbed: he detected it in the liver, spleen, and kidneys of animals poisoned by it ("Ann. d'Hyg.," 1842, 2, 217). A fatal case of poisoning by *nitrate of barium*, taken in mistake for sulphur, is reported (*Pharm. Jour.*, 1869, p. 181). Another fatal case is recorded in the same journal for June, 1872, p. 1021.

A man employed in sizing cotton swallowed a portion about the size of a bean, thinking he was taking Epsom salts. He died in about fourteen hours. The symptoms were at first those of irritant poisoning, but in the later stage paralysis took place. The medical witness stated that he had found twelve grains of this salt sufficient to kill a dog.

In March, 1892, a female servant was given one hundred and fifty grains of chloride of barium in mistake for Carlsbad salts. In twenty minutes she vomited. After two hours she was collapsed, with convulsive twitchings of the mouth, a rapid and feeble pulse, pain in the region of the stomach, and profuse watery diarrhœa. The vomited matter contained much blood. Death occurred in about two and a half hours. No post-mortem examination was made.

Carbonate of Barium is said to have destroyed life in two cases, in each of which only one drachm was taken; but the following case shows that this compound is not so poisonous as the chloride. A young woman swallowed half a teacupful of the powdered carbonate, mixed with water, at a time when she had been fasting twenty-four hours. There was no particular taste. In two hours she experienced dimness of sight, double vision, singing in the ears, pain in the head, and throbbing in the temples, with a sensation of distension, and weight at the pit of the stomach. There was also palpitation of the heart. After a time she complained of pain in the legs and knees, and cramp in the calves. She vomited twice a fluid like chalk and water. The skin was hot and dry, the pulse frequent, full, and hard. These symptoms gradually abated, and she recovered, although the pain in the head and stomach continued for a long time (*Med. Gaz.*, vol. 14, p. 448).

A female, æt. 28, finding herself pregnant, took an unknown quantity of carbonate of barium with suicidal intent. About 6 p.m. she vomited, and had severe pain in the stomach. She slept well, however, without further vomiting. Next morning after breakfast, at 7 a.m., vomiting was repeated; nevertheless, she walked to her situation about three miles distant, where she arrived about 9 a.m. She then looked pale and anxious, and complained of severe abdominal pain. She went to the privy repeatedly, either on account of diarrhœa or tenesmus. Nevertheless she attended to her duties as a domestic servant, but the vomiting and desire to go to stool persisted. At 2 p.m. she went to bed. At 4 p.m. she was found cold, pale, restless, and weak. There was no vomiting. At 8 p.m. she had alternate flushings and rigors. Speech was a mere indistinct whisper. Swallowing was difficult, and respiration laboured. At 3 a.m. she was distressed, the breathing was short; she was perfectly conscious. She was found dead at 4 a.m., thirty-four hours after the commencement of symptoms. The exact time at which the poison was taken was not ascertained.

POISONING BY MERCURY AND ITS SALTS.

Source and Methods of Occurrence.—Mercury is a metal very largely indeed used in arts, commerce, and in medicine. Its source from mines is interesting, as in the course of thus obtaining it for commercial purposes the workmen appear to suffer from chronic affections due to the metal. It is peculiar amongst metals in that it seems very easily to gain access to the body through the unbroken skin or through a sore either by rubbing in of ointments or by exposing the body to an atmosphere in which mercury exists as a vapour (mercury can easily be volatilised by an ordinary spirit lamp). Thus it happens that, however administered and in whatever combination, the specific effect of mercury on the body may easily be obtained. This is quite apart from the most recent attempts to introduce materials into the body by ionisation by means of electric currents.

At the Winchester Lent Assizes, 1859 (*R.* v. *Crook*), a quack was convicted of manslaughter by applying corrosive sublimate in powder to a cancerous tumour in the face of deceased. The man suffered from the usual symptoms. After death the bowels were found extensively inflamed and ulcerated. Corrosive sublimate was detected in the diseased part. A girl, æt. 9, died from the effects of this poison, locally applied to the scalp for the treatment of ringworm. The liquid applied was alcohol containing eighty grains of corrosive sublimate to the ounce. She suffered from mercurial poisoning in a severe form, and died on the fifth day after the application (see *Pharm. Jour.*, September 9th, 1871, p. 216; *Lancet*, 1871, 2, 413; and *Med. Times and Gaz.*, 1871, 2, 353). No idiosyncrasy is required to account for death under such circumstances. In the first edition of the author's work "On Poisons" (1848), p. 394, fatal cases are related of poisoning by corrosive sublimate through the unbroken skin. Two brothers thus lost their lives, the one dying on the fifth, and the other on the eleventh day.

Acid nitrate of mercury has often been employed by accoucheurs as a local application in diseases of the neck of the uterus. In one instance in which it was thus used, the ordinary symptoms of mercurial poisoning showed themselves, and the patient appears to have suffered severely (*Med. Gaz.*, vol. 45, p. 1025). In another case the application of the acid nitrate to the skin produced an eschar, and under the symptoms of mercurial poisoning caused the death of the patient on the ninth day. The mucous membrane of the stomach and intestines presented an arborescent redness, with patches of ecchymosis. Mercury was found in the liver (*Edin. Month. Jour.*, 1864, p. 168). In one case death took place under the usual symptoms from the external application of the nitrate in a liniment (*Edin. Month. Jour.*, August, 1864, p. 167).

The following forms of mercury and its compounds have been known to cause symptoms of poisoning:—

1. Mercury in metallic form; simple medicinal forms.
2. Calomel.
3. Mercuric chloride; corrosive sublimate.
4. White precipitate.
5. Red precipitate.
6. Cinnabar or vermilion.
7. Cyanide of mercury.
8. Mercuric sulphate.
9. Turpeth mineral.
10. Nitrates of mercury.
11. Sulphocyanide of mercury.

1. **Metallic Mercury** is not usually regarded as a poison, but may be a noxious thing. A large quantity of it in the fluid state may often be swallowed without affecting health, or without causing more uneasiness than that which may arise from its great weight. It may, however, when swallowed produce salivation and the other constitutional effects of mercury. It rapidly passes through the bowels. If the mercury is breathed or swallowed in a state of vapour, or if applied to the skin or mucous membranes in a state of minute mechanical division, in which state it appears to be easily susceptible of oxidation, it is liable to be absorbed, and to produce a poisonous action on the body. Symptoms of poisoning by the metal are occasionally seen in workmen engaged in trades in which they are exposed to the inhalation of mercurial vapours. Cases of mercurial poisoning are not so frequent as those of poisoning by arsenic. In England and Wales, in the year 1891, six deaths from mercurial poison were recorded.

Blue pill and *mercurial ointment* are preparations in which mercury is finely divided, and probably, as in the mixture of mercury and chalk, more or less oxidised. A woman is reported to have died from taking excessive doses of blue pill (*Med. Times and Gaz.*, 1863, 1, p. 466). Blue or mercurial ointment, which contains nearly half its weight of mercury, has attracted attention by reason of its poisonous effects on cattle. It is employed for the purpose of dressing sheep, in place of arsenic, and twenty-five tons of this ointment were sold in one year by a druggist in Boston, chiefly to farmers. Sheep poisoned with mercurial ointment have been sent for sale to the dead-meat markets in London. This is an (usually) unsuspected source of a noxious element in food for human beings.

Mercury with chalk is commonly regarded as an innocent medicinal compound of the metal, but if long kept and exposed to light a portion of the mercury passes to the highest state of oxidation, and thus produces a poisonous effect upon the system. This may account for the severe symptoms which have sometimes resulted from this preparation in medicinal doses. Duncan and Seely state that in one specimen which should have contained 37·5 parts of metallic mercury 4·05 parts had become converted into black mercurous oxide, and 22·25 parts into red mercuric oxide.

2. **Calomel** (*Mercurous Chloride—Subchloride of Mercury*).—This substance, although commonly regarded as a mild medicine, is capable of destroying life, in small doses, by causing excessive salivation with ulceration and gangrene, and in large doses by acting as an irritant poison.

3. **Corrosive Sublimate.**—This substance has received a variety of chemical names. It has been at various times called *Oxymuriate*, *Chloride*, *Bichloride*, *Mercuric Chloride*, and *Perchloride* of *Mercury*. To prevent any confusion from scientific chemical nomenclature, the old and popular name of *Corrosive Sublimate*, expressing the principal properties of the substance, is here retained. It is commonly seen under the form of heavy crystalline masses, or of a white crystalline powder. Its *taste* is powerfully astringent and metallic, so that no poisonous quantity of it could be easily swallowed without a person becoming immediately aware of it. It is very *soluble* in water, hot or cold, and speedily sinks in it, in which properties it differs strikingly from arsenic. One hundred grains of a cold saturated solution hold dissolved about seven grains of corrosive sublimate, and one hundred parts of boiling water (212° Fahr.) will dissolve sixty parts of the poison. It is also readily dissolved by alcohol and ether.

The following note from the *Lancet*, 2, 1893, p. 506, shows one means of accidental poisoning by corrosive sublimate:—

> "Anna Ruppert was charged by the Pharmaceutical Society of Ireland with selling a certain skin specific containing poison and with not being duly licensed under the Pharmacy Act. Evidence was adduced proving that the preparation in question, which was known as 'Ruppert's Skin Tonic,' was purchased at a shop in Grafton Street, over the door of which was the name of Anna Ruppert. The poison contained in this preparation was corrosive sublimate to the extent, according to Professor Tichborne's analysis, of eight grains to the bottle. We have had occasion ourselves to submit this 'tonic' to analysis, and found that there were present in solution 1·6 grains of corrosive sublimate in each fluid ounce, so that a bottle of half-pint capacity would hold nearly thirteen grains of perchloride of mercury, a fourth of which quantity has been known to be sufficient to produce fatal results. Yet the preparation is described as being a perfectly harmless astringent for cleansing the skin and removing freckles. It is true that it is recommended for external use only, but the ease with which mercurial compounds are absorbed through the skin is well known, two cases of death, in fact, being on record as resulting from the application of corrosive sublimate in this manner."

4. **White Precipitate** (*Ammonio-Mercuric Chloride—Ammoniated Mercury*).—In 1850, a woman who was indicted for administering this substance to her husband, owed her acquittal to the lenient assumption

in her favour that it was *not* a poison. Out of fourteen cases which the author collected, in which white precipitate was taken in doses varying from a few grains to forty, two only proved fatal; and one of these was the subject of a trial for murder (*R.* v. *Moore*, Lewes Lent Ass., 1860).

5. **Red Precipitate** (*Mercuric Oxide—Red Oxide of Mercury*).—This substance is poisonous, but instances of poisoning by it are rare.

The following case occurred at Guy's Hospital in 1833. A woman, æt. 22, who had swallowed a quantity of red precipitate, was brought in labouring under the following symptoms:—The surface was cold and clammy, there was stupor approaching to narcotism, frothy discharge from the mouth, and occasional vomiting: the vomited matters contained some red powder which was proved to be red precipitate. There was considerable pain in the abdomen, increased by pressure; and there were cramps in the lower extremities. On the following day the throat and mouth became painful, and she complained of a coppery taste. The treatment consisted in the use of the stomach-pump, and the free administration of albumen and gluten. She left the hospital four days afterwards, still under the influence of mercury. The quantity of oxide taken was not ascertained.

In 1879, a woman was treated in Guy's Hospital, who had taken red precipitate and laudanum. Severe abdominal pain, vomiting, and bloody purging, were the most prominent symptoms. The woman recovered without salivation.

6. **Cinnabar — Vermilion** (*Mercuric Sulphide*). — The term *Cinnabar* is applied to a dark and heavy compound of sulphur and mercury, while *Vermilion* is the same substance reduced to a fine powder. It is well known as a red pigment, and is sometimes employed in colouring confectionery and wafers. It is stated to have proved fatal to animals in quantities of from thirty to seventy grains when applied externally to a wound. Cinnabar is sometimes used for giving a red colour to ointments, *e.g.*, sulphur ointment, and it is also employed as a colouring matter in vulcanised rubber for mounting artificial teeth. Although this insoluble compound of mercury cannot be regarded as an active irritant poison in the stomach, the placing of it in such a situation that it should be always in contact with the mucous fluids of the mouth is liable to lead to the usual consequences of chronic poisoning by mercury. Mr. Frank Farmer informs the editor that this substance is still used to colour the cheaper forms of rubber used for palates. It is excluded from the better class goods (prices respectively are 8*s.* and 26*s.* a pound), the substitute is a trade secret, but guaranteed free from mercury. Mr. Farmer has seen many cases of unpleasant results from the cheap rubber.

In 1864 a medical man consulted the author under the following circumstances. Upon the recommendation of a dentist, he had worn this red composition as a frame for false teeth, in place of gold. After some time he perceived a metallic taste in his mouth, the gums became inflamed and ulcerated, there was great weakness and want of nervous power, with pains in the loins and an eruption on the legs. When the composition was removed these symptoms abated. The substance contained a large quantity of vermilion: it had been mixed with the sulphur and rubber to give the appearance of the red colour of the gums. Wells has directed the attention of professional men to accidents of this nature. A patient of his, who had been provided with a frame of this description for the upper and lower jaws, perceived, soon after wearing it, a metallic taste in his mouth. His health failed, he lost his appetite and became emaciated: he suffered from flatulency, fœtid breath, and looseness of the bowels: his pulse was 100 and weak, and his tongue coated with a white film. This man was peculiarly sensitive to the action of mercury. He left off wearing the teeth, and became gradually better and stronger (*B. M. J.*, 1863, 2, p. 266).

Sutre published a short abstract of a case in which the vapour of vermilion, applied externally, produced severe symptoms. A woman, by the advice of a quack, applied this vapour to a cancerous breast. She employed three drachms of vermilion, and covered herself with a sheet, so that the vapour should only reach the body externally. After three fumigations, she suffered from severe salivation and violent fever, which continued for four weeks. The right arm became œdematous (*Med. Times*, September 27th, 1845, p. 17).

7. **Cyanide of Mercury** (*Mercuric Cyanide*).—This substance is an active poison, and has caused death in at least two instances. In 1823, a person who had swallowed twenty grains of this compound was immediately seized with all the symptoms of poisoning by corrosive sublimate, and died in nine days (Orfila, vol. 1, p. 735). Christison quotes a case in which ten grains destroyed life within the same period of time (*op. cit.*, p. 427). As a poison, the cyanide is not much inferior in activity to corrosive sublimate, but it has no corrosive properties.

8. **Mercuric Sulphate.**—A case of suicide from this corrosive poison occurred in November, 1891.

9. **Turpeth Mineral** (*Basic Mercuric Sulphate—Subsulphate of Mercury*).—Fatal cases of poisoning by this compound are by no means common. Although insoluble in water, it is undoubtedly an irritant poison, and is capable of causing death in a comparatively small dose.

A well-marked instance of its fatal operation was communicated to the Pathological Society in 1847. A boy, æt. 16, swallowed *one drachm.* The patient died in about a week after taking the poison, without convulsions, and without suffering at any period from symptoms of cerebral disturbance. Mercury was detected in the intestines (*Med. Gaz.*, vol. 39, p. 474). Another case was the subject of a trial for manslaughter at the Stafford Lent Assizes, 1862. A young man, æt. 27, by the mistake of a druggist, was supplied with turpeth mineral in place of Æthiop's mineral. He swallowed about forty grains of it, on an empty stomach, with a like quantity of cream of tartar and treacle. Under treatment the symptoms of irritation abated, but never entirely subsided, and he died quietly on the eleventh day after taking the poisonous mixture. A small portion of the liver yielded mercury when treated with copper and hydrochloric acid.

10. **Nitrates of Mercury.**—These are corrosive poisons which are used for various purposes in the arts. They are solid white salts, easily dissolved by cold water when there is a little excess of acid present. The acid mercuric nitrate has caused death.

11. **Sulphocyanide of Mercury** is the chief constituent of the articles known as Pharaoh's serpents; it is stated not to be very poisonous, yet in a case in which these gave rise to an action (*vide Lancet*, 1, 1897, p. 605), a lady ate a "serpent" by mistake and was very ill.

Toxicity and Fatal Dose.—Mercury offers a remarkable illustration of the difference produced by chemical combination so far as toxicity is concerned. For instance, the difference between the amount of calomel and of corrosive sublimate that can be given without a likelihood of any unpleasant symptoms is very extraordinary; three grains of the latter would almost inevitably entail death if not vomited, whereas three grains of the former is but a very ordinary medicinal dose. The fact that the so-called persalts of mercury are many times more active than the subsalts (the chloride and iodide are the common medicinal examples), forms a very important item in the answer to the question, "Was this person poisoned by mercury?" It will be further noted under the analysis.

Of the various preparations and salts of mercury the fatal doses of which have been recorded, the following may be cited:—

The *smallest* doses of corrosive sublimate which have destroyed life are *two* and *three* grains respectively. These were the cases of children; the quantities were accurately determined from the fact of its having been made up by mistake for calomel, which it was intended to prescribe (*Lancet*, 1845, p. 297). It is probable that, under favourable circumstances, from three to five grains, or even less, would destroy an adult. Persons who had taken large doses have been known to recover when remedies were timely administered, or early vomiting was produced (*Med. Times and Gaz.*, 1860, 1, p. 162); and sometimes recovery has been wrongly attributed to the remedy.

A man swallowed eighty grains of corrosive sublimate dissolved in whisky and water. In ten minutes violent vomiting occurred. A mixture of albumen and milk was first given, and in about twenty-five minutes, gold-leaf with reduced iron made into a bolus. Some warm water had been previously administered in order to clear the stomach of any albumen or mucus. Vomiting recurred with less violence, the matters being mixed with gold-leaf. On the next day there was no salivation, and in about eight days the man perfectly recovered (*Amer. Jour. Med. Sci.*, April, 1863, p. 340). The recovery was attributed to the gold and iron, but there is no evidence that the metals had exerted any action in decomposing the corrosive sublimate; on the contrary, the particles of gold-leaf rejected after the administration of the antidote were apparently unchanged. The recovery was, doubtless, due to the early vomiting, and the free use of albumen and milk.

Pavy's experiments on dogs and rabbits show that white precipitate is a more formidable poison than it was formerly supposed to be. The greater number of recoveries were probably owing to the substance being early ejected by vomiting. Rabbits, which do not vomit, were killed by a dose of four or five grains in a few hours. After death, mercury was found deposited in various organs, but more in the kidneys than in the other viscera. (For additional facts connected with the action of this poison, see Guy's Hosp. Rep., 1860, p. 483.)

Of turpeth mineral, forty and sixty grains respectively have proved fatal.

Of nitrate of mercury a drachm has proved fatal, probably more due to the nitric acid than to mercury.

Of the cyanide twenty grains have proved fatal.

As facts these doses may remain, but owing to the vomiting in cases in man they tell us nothing as to the real amount necessary to kill after absorption.

There can be no doubt, too, that mercury is a drug for or against which many people have an idiosyncrasy. Thus, in 1881, Sir Thos. Stevenson was consulted respecting a lady whose life was brought into jeopardy by the administration of one dose of 1-32nd of a grain of corrosive sublimate. There were the symptoms of severe irritant poisoning, and collapse, followed by salivation. It was clearly demonstrated by two independent analyses that the single dose of medicine contained only the 1-32nd of a grain of the poison. This is a very exceptional case, but every physician is aware of the tolerance of children towards calomel.

Duration.—The symptoms in acute cases come on within a very few minutes. They are rarely, if ever (the editor cannot find a case of delay), delayed more than ten minutes, thus contrasting rather markedly with arsenic, *q.v.*

In an acute case, a person commonly dies in from one to five days; but death may take place much sooner or later than this. In the shortest fatal case on record, the quantity of poison taken was not ascertained, but the man died in less than *half an hour.* In a case reported in the *Edin. Month. Jour.*, 1860, vol. 1, p. 958, an adult who took from sixty to eighty grains of corrosive sublimate, did not die until the *twelfth day.* On the first day there was no complaint of pain in the gullet or stomach; the throat was painful on the second day, and the mouth and gums were affected on the third day. On the eighth day the man had apparently recovered, but he gradually became weaker, and died on the twelfth day. In one case (*Lancet*, 1862, 1, p. 119), a large dose of corrosive sublimate (112 grains) caused death in *three hours and a quarter.* In another, which occurred in 1861, about five grains of corrosive sublimate caused death in six days; in both cases the poison was taken in solution.

Symptoms.—In extreme cases there is a very marked distinction to be drawn between the symptoms of acute and chronic mercurial poisoning, though it must be admitted that in many cases the symptoms of both forms occur together. Summed up in a line, the acute cases are ones of irritant (to the stomach) poisoning, the chronic ones show effects on the organs (glands, nerves, etc.), into which the mercury is absorbed.

In the acute cases the particular salt swallowed seems to have no particular relation to the symptoms produced.

In the first place there is perceived a strong metallic taste in the mouth, often described as a coppery taste; and there is during the act of swallowing a sense of constriction almost amounting to suffocation, with burning in the throat, extending downwards to the stomach. In a few minutes violent pain is felt in the abdomen, especially in the region of the stomach, and increased by pressure. Pain in the abdomen has been sometimes wholly absent. There is nausea, with frequent vomiting of long stringy masses of white mucus, mixed with blood; and this is followed by profuse purging. The countenance is sometimes swollen and flushed, in other cases it has been pale and anxious. The pulse is small, frequent, and irregular, and is scarcely perceptible when the symptoms become aggravated. The tongue is white and shrivelled—the skin cold and clammy, the respiration difficult; and death is commonly preceded by fainting, convulsions, or general insensibility. The external parts of the mouth, when examined, are swollen, and sometimes present an appearance as if the cavity has been washed with a solution of nitrate of silver; the lips are often swollen. Suppression of the urine has also been frequently noticed among the symptoms. It occurred in a well-marked case in which the patient lived four days, but did not pass any urine during the whole of this time (Guy's Hosp. Rep., 1844, p. 24). This symptom was observed in a case reported by Wegeler (Casper's *Wochenschrift*, January, 1846, p. 30), in which a youth, æt. 17, swallowed three drachms of this poison, and died on the sixth day. During the last three days, no urine was secreted. The case was otherwise remarkable from the fact that no pain was experienced on pressure of the abdomen, and that the pulse underwent no change until shortly before death. In another case, in which twenty grains of corrosive sublimate in solution were swallowed, suppression of urine and salivation came on on the third day, and the patient died on the ninth day (*Lancet*, December 13th and 27th, 1845, pp. 650, 698). In another case the quantity of urine secreted was small, and it produced a scalding pain when voided (*Prov. Med. Jour.*, November 18th, 1843, p. 126). In this instance there was no purging.

The symptoms produced by **corrosive sublimate**, in the first instance, resemble those of cholera; if the individual should survive several days, they are more like those of dysentery—violent straining, and mucous discharges mixed with blood, being very frequently observed.

A man, æt. 54, swallowed two-pennyworth of the poison (a quarter of an ounce) at 11 a.m. When seen, soon afterwards, he was on the bed in a state of great prostration; his skin was blanched, and covered with a cold clammy perspiration; he vomited a thick, stringy, glairy substance. There was intense pain over the abdomen, and great purging with discharge of blood; the pulse was scarcely perceptible, the tongue and the interior of the mouth were perfectly white from the local action of the poison. White of egg was given freely, and a mustard poultice applied to the abdomen. At one o'clock he was more depressed. At a quarter past two he expired. An inspection was made twenty-four hours after death. The external coat of the stomach was of a deep red colour. The mucous membrane internally had the appearance of a piece of dark crimson velvet. The intestines here and there were reddened. The large omentum for about an inch from the stomach was of a deep crimson hue. The other organs were healthy.

In another case, in which five grains of the poison, dissolved in vinegar, were swallowed by a man, æt. 25, the following symptoms were observed. Immediately after swallowing it, he felt a burning heat in his throat, and vomited freely. In two hours, there was great pain in the abdomen, he passed blood in his evacuations, and brought up a thick yellow frothy matter, tinged with blood. There was suppression of urine. He died on the sixth day. On inspection, the gullet presented marks of the local action of the poison. The mucous membrane of the stomach was reddened, and throughout minutely injected. There was no appearance of corrosion. The small intestines at their lower part, as well as the large intestines, were deeply injected. The cæcum was but slightly affected. Seven ounces of the liver, and one half of the stomach, yielded only minute traces of mercury. The greater part of the poison had been discharged by vomiting or by elimination during the six days which the patient survived. Thus, in spite of the removal of the poison from the stomach, the case may prove fatal. Eade reported a case in which a man swallowed a lump of corrosive sublimate: it was ejected from his stomach in about an hour. It was then smooth on the surface, and weighed about one drachm. The usual symptoms of mercurial poisoning followed, with suppression of urine. There was slight salivation on the fifth day, and the man died on the eighth day. Mercury was found in the liver (*Lancet*, 1870, 1, p. 303.)

In the following case, reported in the *Med. Gaz.*, vol. 6, p. 315, it is probable that free nitric acid shared in the event. A boy dissolved some mercury in strong nitric acid, and swallowed about a teaspoonful of the solution. Soon afterwards he suffered excruciating pain in the throat, gullet, and stomach:—there was great anxiety, with cold skin, small pulse, colic and purging. He became gradually weaker, and died in about two hours and a half. On inspection, the throat, gullet, and stomach were found corroded and inflamed. Although he survived so short a time, the mucous membrane of the stomach was of a deep red colour. The author met with a case in which the application of mercuric nitrate to the throat as an escharotic, caused immediate death by asphyxia (Guy's Hosp. Rep., 1850, p. 206).

At the Leicester Summer Assizes, 1857, a girl was charged with administering **nitrate of mercury** to her mistress (*R.* v. *E. Smith*). The evidence showed that the accused had put the poison into some camomile tea prescribed for the prosecutrix. Only a small quantity was taken, as the tea had a nauseous taste. The symptoms were, a burning sensation in the throat and stomach, violent vomiting, and severe pain in the abdomen. The woman recovered.

With regard to **white precipitate,** the symptoms which it produces are violent vomiting, cramps, purging, and pain in the stomach, with convulsions. After death there is more or less inflammation of the stomach and bowels.

A woman, æt. 30, swallowed a pennyworth of white precipitate, and shortly afterwards a pennyworth of acetate of lead. In half an hour there was violent vomiting, with pain over the whole of the abdomen. An hour and a half afterwards the symptoms were, in addition to the abdominal pain, great thirst and a comatose condition. On the second day there was slight tenderness of the gums, a flow of saliva, flushed face, with great tenderness of the abdomen; and on the fourth day profuse salivation. This subsided on the tenth day, and the woman recovered (*Med. Times and Gaz.*, 1863, 2, p. 645). A young woman swallowed about thirty or forty grains of this substance by mistake for carbonate of sodium. The chief symptoms were pain in the stomach and a spasmodic twitching of the muscles of the left arm and leg. These spasms continued for twenty-four hours. Emetics were given, and she recovered (*Lancet*, 1871, 2, p. 540).

In 1877, a woman, æt. 30, was admitted into Guy's Hospital three hours and a half after having taken two-pennyworth, or "a good teaspoonful," of white precipitate. Within a few minutes of swallowing the poison vomiting and severe burning pain in the stomach came on. Twenty minutes after administration an emetic of ipecacuanha was given. On admission an emetic of sulphate of zinc was administered. The expression was anxious, the pulse and respiration were quickened: there was great thirst, severe vomiting, and great pain in the abdomen. The bowels acted frequently. She made a good recovery, and was discharged in nine days, no salivation having appeared.

In 1878, a man, æt. 66, took thirty grains of white precipitate. He vomited almost immediately. With the exception of a feeling of soreness in the throat his symptoms were not severe. In 1879, a third case, that of a woman, æt. 26, was admitted into Guy's Hospital. The patient had taken three-pennyworth of white precipitate in milk. There was speedily severe burning pain in the region of the stomach, and a metallic taste in the mouth. She vomited on admission, and the vomit was found by Sir Thos. Stevenson to contain white precipitate. An emetic of sulphate of zinc and ipecacuanha was speedily followed by renewed vomiting. Purging set in next day. The woman recovered. Four days after the administration of the poison salivation appeared and continued for a few days.

Chronic Poisoning.—If mercurial salts are used with "devilish cunning" for homicidal purposes we may get a succession of mild attacks of the acute symptoms with remissions; such cases are, however, rare, and chronic cases more commonly arise from unintentional medicinal overdoses or from working amongst the vapours of mercury or the dust of its salts. There are colicky pains, with nausea, vomiting, general uneasiness, and depression. The salivary glands become inflamed and painful; the tongue and gums are red, swollen, and sometimes ulcerated, and there is fœtor of the breath. A deep blue line, somewhat like that observed in poisoning by lead, is sometimes found around the edges of the gums. The patient experiences difficulty of swallowing and breathing. The constitutional effects are indicated by looseness of the bowels, difficulty of breathing, spitting of blood, cough, general trembling or convulsive movements of the limbs and palsy, with slow fever and emaciation, under which the patient sinks. One of the most marked effects of slow or chronic poisoning by mercurial preparations is *salivation*, or ptyalism, indicated by an increased flow of saliva. This is by no means a necessary symptom in cases of acute poisoning by corrosive sublimate, but it not unfrequently shows itself about the second or third day. In some instances the patient dies too rapidly for this effect to follow; but even when he survives some days, salivation is not always observed. In placing reliance upon this symptom, it must be remembered that salivation may arise from a variety of causes irrespective of the use of mercury. Another result is the peculiar mercurial erethism, as it is termed, or affection of the nervous system. There is great mental excitability of the patient to external impressions. An unusual word disturbs him; and the question of the physician may cause him to grow pale, stammer, and become profoundly agitated. He is anxious without reason, sleepless, and disturbed by dreams. This condition after a variable period passes into the stage of mercurial tremor, or "trembles," as it is vulgarly termed. The tremor begins in the tongue, face, and arms, as a slight quivering, especially noticeable when the patient speaks, and it increases till convulsive twitchings are produced, extending over the whole body, and sometimes rendering locomotion impossible. The tremor disappears during sleep, and is increased by the slightest attempt at voluntary effort, or by mental emotion of any kind. If the patient be requested to hold out the hand or to protrude the tongue, these acts are done in a jerky manner; and attempts to walk result in the most grotesque contortions. As mercury may be easily detected in the saliva by a process to be described, the discovery of the metal in this fluid will show the real cause of the salivation.

A man, æt. 32, suffering from chronic poisoning by the nitrate of mercury, was admitted into Guy's Hospital in 1863. He had been for four years engaged in packing the fur of rabbits, rats, and other animals, the dried skins of which had been previously brushed over with a solution of nitrate of mercury. For the first three years he suffered only from a feeling of general weakness. For about a twelvemonth he could not hold his hand steadily enough to shave himself, and he soon afterwards lost completely the control over the voluntary movements of his limbs. Three or four months before his admission he had had slight twitchings of his muscles when in bed. He was not at all emaciated. He said he had been salivated for about three months, soon after he began his occupation of packing furs; but his gums were not tender, and he had no metallic taste in his mouth. A month before his admission he gave up his work. When he became a patient he could walk with assistance, but on standing or lying down he could not control his limbs, which trembled considerably. There were continued involuntary movements of his body and limbs, like those of chorea. He became much exhausted, owing to want of sleep, and perspired profusely. The urine was highly coloured, but otherwise natural. Twelve ounces of it did not yield any mercury. No treatment appeared to give him rest or relief. Chloroform arrested the spasmodic movements, but only while he was under its influence. In five days he passed his urine involuntarily. He was quieter and slept a little at night. He had difficulty in swallowing, became gradually weaker, and died, apparently from exhaustion, a fortnight after his admission. On inspection, the body was well nourished; the muscles were firm and healthy. The brain and spinal cord were found to be quite healthy. The lungs, heart, liver, spleen, and kidneys were free from any morbid appearance, or any change to indicate a cause of death.

An analysis was made of the brain, liver, and kidney. Six ounces of each organ were dried, and one-half of the dried residue, treated with hydrochloric acid and water, as elsewhere described, gave, in forty-eight hours, on a small portion of copper-gauze, a greyish, white deposit, which yielded globules of metallic mercury when heated. The kidney yielded the largest sublimate; but the quantity obtained from each organ was small, and might be described as mere traces. The globules from the brain and liver had an average size of one two thousand six hundredth of an inch; those from the kidney were larger. In the fur similar to that which the man had been engaged in packing a small quantity of a soluble salt of mercury was readily detected. The case, which at first presented some difficulty in accounting for death, thus resolved itself into one of exhaustion as a result of chronic poisoning by mercury under somewhat unusual circumstances. It is probable that the man received the dust of the dried nitrate through the air which he breathed, as well as by contact with his mouth, nostrils, and skin. As other workpeople similarly engaged were not found to have suffered, this may have been a case of mercurial poisoning due to idiosyncrasy.

Similar but milder symptoms are frequently seen when mercury is being administered by inunction; they speedily subside on cessation of the treatment, but the teeth may be lost if inunctions are persisted with.

Post-mortem Appearances.—These, as in the case of arsenic, are chiefly confined to the stomach and bowels. Corrosive sublimate, however, affects also both the mouth and throat; the mucous membrane is softened, of a white or bluish-grey colour, and sometimes inflamed; that which lines the gullet is similarly affected, partly corroded and softened. The mucous membrane of the stomach is more or less inflamed, sometimes in patches; and there are masses of black extravasated blood found beneath it. Occasionally it has a slate-grey colour, and the mucous coat beneath may be found reddened. A case occurred in Guy's Hospital, in which the mucous membrane was simply inflamed: it much resembled the condition presented in cases of arsenical poisoning. The coats of the stomach are sometimes corroded, and so much softened that the organ cannot be removed from the body without laceration. Similar appearances have been met with in the small and large intestines, especially in the cæcum. In a case in which twenty grains were taken, and death occurred on the ninth day, the mucous membrane of the stomach was softened, but there were no well-marked appearances of the action of the poison on this organ. The cæcum had been the seat of violent inflammation, the whole surface being of a deep black-red colour, and there were patches of sloughing in the coats (*Lancet*, December 27th, 1845, p. 700). In a case in which a man died forty hours after having swallowed 120 grains of corrosive sublimate in powder, the mucous membrane of the stomach, duodenum, upper portion of the ileum, and parts of the large intestines, were found of a bright red colour. This appearance was most marked at the cæcum and sigmoid flexure of the colon. The local action of the poison on the mouth and throat was in this instance considerable (*Edin. Month. Jour.*, December, 1851, p. 532). Perforation of the stomach is rare as an effect of this poison; there is, perhaps, only one case on record.

Appearances like those just described have been seen in the alimentary canal, not only where the case has terminated fatally in a few hours, but where it has been protracted for six, eight, and even eleven days. In the case of a man, æt. 42, who swallowed, by mistake, thirty grains of corrosive sublimate in solution, and who died on the twelfth day, the stomach was found empty and the mucous membrane was of a dull, dark-red colour, chiefly about the smaller curvature. This organ was softened, and near the intestinal end was grey, pulpy, and gangrenous. In the gullet, the lining membrane appeared to have been stripped off in shreds. The intestines were in a state of intense inflammation, passing into gangrene. The other viscera presented no particular appearance. In this case the symptoms were manifested in a few minutes: there was a burning pain extending down the gullet to the stomach, described as if the parts were on fire ; there was no mark of corrosion in the mouth ; there was a sensation as if the throat were "grown up" ; and there was blood in the vomited matters as well as in the evacuation. There was no salivation at any period (*Med. Times and Gaz.*, 1859, 1, p. 210).

Unless appearances of acute irritation such as the above are present, it is impossible without analysis to ascertain that mercury has caused death, for it leaves no visible traces in the tissues.

Chemical Analysis.—A person **may die** from the effects of corrosive sublimate, **and no mercury may be found** in the tissues. A case of this kind occurred some years since at Guy's Hospital ; and another, in which deceased died in fifteen days from a large dose of corrosive sublimate in whisky, has been reported by Geoghegan. On this occasion, although the local effects of the poison on the throat, stomach, and bowels, were of an intense kind, the viscera, on careful analysis, yielded no trace of mercury ; the metal had been entirely eliminated in fifteen days (*Med. Gaz.*, vol. 46, p. 253).

Corrosive sublimate is usually seen as a *solid* in heavy crystals, or in the form of a white crystalline powder. (1) When the powder is heated on platinum-foil it melts, and is volatilised as a white vapour without leaving any residue. (2) When heated in a close tube it melts and forms a sublimate, consisting of prismatic crystals in stellate groups. (3) The powder is changed in colour by the following reagents: iodide of potassium produces a bright scarlet, potash a yellow, and sulphide of ammonium a black mass ; ammonia does not alter its colour. (4) The mercury and chlorine may be discovered by one process. Mix the powder with four parts of dried carbonate of sodium (obtained by incinerating the bicarbonate), until the residue in the reduction-tube fuses and becomes white. A sublimate of metallic mercury in distinct and well-defined globules will be obtained. Cut off the end of the tube containing the fused residue, which is chloride of sodium with some undecomposed carbonate. Digest it in water with nitric acid, and apply heat until it is entirely dissolved ; then add nitrate of silver to the solution. A white precipitate of chloride of silver, insoluble in nitric acid, will be at once produced. The solid is thus proved to contain both mercury and chlorine, and the only compound of these elements soluble in water is corrosive sublimate. Corrosive sublimate is dissolved by water and alcohol. A few drops of the aqueous solution evaporated on a glass slide yield slender opaque silky prisms. The crystals obtained from the alcoholic solution are larger and better defined. When a weak solution of iodide of potassium is dropped on them, they acquire a bright scarlet colour. These characters, which may be obtained from the minutest crystal and only one drop of solution, prove that the body dissolved in water is corrosive sublimate; it is thus distinguished from every other mineral poison, and all other substances whatsoever. (1) Stannous chloride added to a solution of corrosive sublimate, produces a dark grey precipitate, which, after it has been boiled, is resolved into globules of metallic mercury easily separable by filtration. The chloride should be strong and mixed with its volume of strong hydrochloric acid. If while boiling the mercurial compound is added to it, there is an immediate precipitation of metallic mercury. The same result is obtained with all compounds of mercury excepting the sulphide. (2) Sulphuretted hydrogen and sulphide of ammonium produce at first a yellow and then a black sulphide, not soluble in alkalies or diluted acids. (3) If the liquid is acidulated, and bright copper foil, wire, or gauze is plunged into it, the copper will acquire a silvery-white deposit, even in the cold, but more rapidly on heating. When the copper with the metallic deposit is heated in a tube, globules of mercury are sublimed.

In Organic Liquids.—The liquid should be separated by filtration from any insoluble portions. The latter should be pressed, dried, and set aside for a separate analysis. Any heavy sediment may be obtained by decantation, dried, weighed, and separately examined. A slip of bright copper foil or gauze may be employed as a trial test for the liquid portion. In place of copper a small electrolytic couple, made by twisting a layer of gold-foil round a layer of zinc-foil, may be introduced. The liquid should be slightly acidulated with hydrochloric acid and warmed. The metals should be suspended in the liquid for some hours. If the mercurial poison is present, even in small quantity, the gold will sooner or later lose its colour and become silvered, while the zinc will be wholly or in part dissolved. The slip of gold-foil may be washed in water, and afterwards in ether and dried. It should be divided into two equal portions. One should be submitted to heat in a tube, when globules of mercury will be obtained; the other should be heated with a few drops of concentrated nitric acid, until the gold has reacquired its yellow colour. On evaporating the excess of acid and adding a solution of stannous chloride, a dark grey precipitate of metallic mercury is thrown down. It may be remarked that sublimed mercury is wholly unlike any other volatile substance. The perfect sphericity of the globules, their silvery whiteness by reflected, and complete opacity by transmitted light, at once identify them as metallic mercury. The sublimate of metallic mercury differs from that of arsenic in the fact that, when heated, it sublimes simply as a metal without change. It is not oxidised (like metallic arsenic), by heating it in a reduction-tube, but is simply transferred with its metallic lustre from one part of the tube to another. The mercurial sublimate is soluble in nitro-hydrochloric acid, yielding on evaporation white prismatic crystals of corrosive sublimate.

The yellow colour of the gold may not have been concealed by the mercurial deposit, owing perhaps to its great tenuity. Hence it is always well to heat the gold in a reduction-tube before coming to the conclusion

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that mercury is absent. The tube itself may not show a sublimate to the naked eye, owing to the minuteness of the globules, and their being much scattered. In all cases it should be examined, at first with a low and subsequently with a high power of the microscope. Minute strings of globules, varying from the one eight-thousandth to the one sixteen-thousandth of an inch in diameter, may thus be detected. They are frequently deposited in a kind of chain in any minute crack or line on the interior of the glass tube. In the event of a doubt existing respecting the mercurial nature of the sublimate, the following experiment will remove it. Cut off by a file the portion of glass on which they are deposited; introduce this into a wide short tube, with a few drops of hydrochloric and half the quantity of nitric acid. Evaporate the acid liquid to dryness on a sand-bath. White prismatic crystals of corrosive sublimate will remain, if the sublimate was of a mercurial nature, and too great a heat has not been applied. On touching the white residue cautiously with a drop of solution of iodide of potassium, the crystals will acquire a scarlet colour.

Another method of analysis may be sometimes usefully resorted to. Place the suspected organic liquid in a small gold capsule, or on a gold coin. Acidulate it slightly with hydrochloric acid, and touch the gold, through the acid liquid, with a slip of pure zinc-foil, or with a steel key. Mercury will be deposited in a white silvery stain on the gold, wherever the two metals have come into contact. Wash out the capsule with distilled water, and add a few drops of strong nitric acid. Mercuric nitrate is thus obtained, which may be tested by the processes above described for the detection of mercuric salts. Any solid precipitates, or insoluble compounds of mercury, may be dissolved by strong nitric acid, and the solution tested for the metal. If none is found, the dried solid, mixed with dried carbonate of sodium, may be heated in a tube, when mercury, if present, will be volatilised. Organic liquids containing any of the poison dissolved may be submitted to dialysis by the method already described under arsenic.

Absorbed and Eliminated Mercury.—Although absorbed mercury, like other metals, is eliminated from the system, yet its elimination through the ordinary secretions appears to be slow, and subject to some uncertainty with respect to the time at which it occurs, as well as to the duration of the process. That it is rapidly absorbed and deposited in the tissues of the organs is undoubted; but when once deposited, the period for its entire elimination can scarcely be predicted. Mercury, in a man or animal labouring under its immediate effects, is not so readily detected in the urine as arsenic. Tuson gave to a mare, at first four grains, and afterwards five grains of corrosive sublimate twice a day. At the end of fourteen days, he tested a pint of urine for mercury, but he found none. After a lapse of three weeks it was easily discovered in this fluid. The animal then left the infirmary. In a case of chronic poisoning by mercury, to be presently mentioned, mercury could not be detected in twelve ounces of urine which were voided while the patient was labouring under the effects of the absorbed poison, although several weeks had elapsed, and mercury was detected in the tissues after death.

In the search for mercury in living persons labouring under this poison, a large quantity of urine should be examined, and an analysis made at intervals. The urine should be evaporated to dryness, and the dry residue or extract treated by the following process, which is the same as that required for the *tissues*. From four to eight ounces of the material should be dried, broken up, and then boiled in one part of pure hydrochloric acid and four parts of water until dissolved. The acid liquid may be strained through linen, and the residue pressed. The liquid, if in large quantity, should now be concentrated by gentle evaporation, and while still slightly warm a small piece of copper-gauze (proved to be free from mercury) should be introduced, at the end of a fine platinum wire, into the acid liquid. The copper may acquire a white, grey, or silvery tarnish in a few minutes or not until after twenty-four hours. It should be removed, washed in water and in alcohol, dried, and examined by a low power of the microscope. The deposition of any white metal on the copper will then be perceptible. It may be rolled into a pellet and heated in a dry reduction-tube, when minute globules will appear as a sublimate. The sublimate in the tube should be examined with a microscope, and the copper should in all cases be heated, whether the red colour of this metal appears to be covered or not by any deposit. The electrolytic couple may also be employed for the deposition of mercury.

If arsenic be present in the tissues at the same time, and the acid mixture be boiled, arsenic and mercury will be deposited together; and when the copper is heated, the globules of mercury will be obtained intermixed with octahedral crystals of arsenious acid. In a case of exhumation after twenty-one months' burial, these mixed sublimates were obtained by the examination of the rectum of the deceased (*R.* v. *Bacon*, Lincoln Sum. Ass., 1857). It appeared in evidence that arsenic had been administered to the woman a day or two before death, and a dose of calomel had been prescribed more recently. This accounted for the presence of the mixed sublimates. Small quantities of mercury are frequently found in the liver, owing to the taking of mercurial purgatives.

Arsenic is not readily deposited on copper in the cold, while mercury is readily deposited at all temperatures from acid liquids. It is better, however, to destroy the organic matter by means of chlorate of potassium and hydrochloric acid, as in the procedure for arsenic, evaporate to dryness, take up the residue with acidulated water, and then immerse in it a slip of gold-foil wrapped round a piece of zinc. In the course of twenty-four hours the gold-foil will acquire a white coating of mercury should this metal be present.

In the living body mercury is eliminated in the saliva as well as by the urine; a good deal passes away as sulphide in the fæces. About one drachm of the saliva will suffice for the detection of mercury by the following process. Acidulate the fluid with one-fourth of its volume of pure hydrochloric acid. Immerse in this a portion of copper-gauze, about the sixteenth of an inch square, attached to a fine platinum wire. Place the tube containing the liquid in a warm place for a few hours. If mercury is present in the saliva, the copper-gauze will be whitened. Other portions may then be introduced until the mercury ceases to be deposited. The pieces of copper should be washed in water, then in ether, dried, examined by a low power of the microscope, and then heated in a small reduction-tube. Globules of mercury, visible under the microscope, will then be obtained. In a case of inunction with mercury the metal was thus detected in the saliva on the third day. There was painful swelling of the salivary glands, with the peculiar metallic taste produced by mercury. This analysis of the saliva may not only furnish evidence that the patient is under the influence of mercurial poison, but it will prove, in a case otherwise doubtful, whether the *salivation* from which a person is suffering is owing to mercury or some other cause. An examination of the saliva should be made in *all* cases of metallic poisoning, as arsenic, antimony, and other metals might be thus detected in the act of elimination from the living body.

The processes above described reveal only the presence of mercury. When the quantity of corrosive sublimate dissolved in an organic liquid is moderately large, it may be removed by means of ether. Place the filtered liquid supposed to contain the poison in a stoppered tube, add to it twice its volume of ether, and agitate the liquid at intervals for half an hour. Allow the liquid to subside, pour off the ether into a watch-glass, and submit it to spontaneous evaporation. As the ether passes off, the corrosive sublimate will be deposited in white silky-looking prisms. These may be purified by solution in water if necessary, and again crystallised. Corrosive sublimate may thus be separated from arsenic and other mineral poisons in solution. If mercury and arsenic are associated in a poisonous mixture, or in the tissues, the arsenic may be entirely separated by distillation. Masses of corrosive sublimate may be sometimes entangled in viscid mucus; and in such cases, the coarse powder being heavy, it may be separated by simply agitating the viscid liquid in water, and then decanting the upper portion suddenly. This poison is precipitated by many organic matters, such as albumen, fibrin, casein, mucous membrane; also by gluten, tannic acid, and other vegetable substances. Thus, then, we cannot always expect to find it in the stomach, in a state of solution. **Mercury is not a constituent of the human body.** The discovery of it in the tissues, therefore, proves that it must have been received *ab extra.*

By one or other of the processes above mentioned we may be able to show the presence of *mercury*, but not of corrosive sublimate, in the body. Whether the mercurial compound had acted as a poison or not, must be determined from symptoms and appearances; whether it had been given or taken as a medicine or not, is a conclusion which must also be determined from other circumstances. The proof that the mercury was really in the form of corrosive sublimate, could only be derived from the discovery of some undissolved portions of the solid poison in the stomach or its contents, or from a separation of the poison itself by means of ether. If thus obtained after filtration of an organic liquid, it would show its presence in the form of a soluble salt. All the soluble salts of mercury are poisonous, and, with the exception of the chloride, are rarely used internally as medicines. If undissolved, the absorbed mercury may have been derived from some mercurial medicine innocently taken by the deceased. Nothing is more common than to discover traces of mercury in the stomach, bowels, liver, kidneys, or other organs of a dead body. No importance can be attached to this discovery in the absence of evidence that the deceased has actually suffered from symptoms of mercurial poisoning. As to the mercury found in the tissues, it may have been derived from a soluble or insoluble medicinal compound, or from exposure to the vapours of the metal or of its salts in various trades.

With regard to the special salts of mercury—

The nitrate, when heated with dry carbonate of sodium in a tube, yields a sublimate of mercury. It also responds to the usual tests for nitrates.

Calomel is known from corrosive sublimate by its insolubility in water, alcohol, and ether; and from white precipitate by its being blackened by alkalies. A mercurial sublimate may be obtained from it by heating it with carbonate of sodium.

Vermilion, or an organic mixture containing it, may be entirely decomposed by nitro-hydrochloric acid. The residue, evaporated to dryness, contains corrosive sublimate. This may be taken up by water and the usual tests applied. Ether will separate corrosive sublimate from the aqueous solution. The vermilion contained in vulcanite is thus readily detected. Red sulphide of mercury is not blackened, like red lead, by sulphide of ammonium, and is not dissolved by hydrochloric acid, like red oxide of mercury. It yields an alkaline sulphide and globules of metallic mercury when heated with cyanide of potassium.

White precipitate is a heavy, insoluble, chalky-looking substance, containing about eighty per cent. of mercury. As it is sold in the shops, it frequently contains corrosive sublimate to the amount of one or two per cent. It is not used internally, but it is much employed by the poorer classes in the treatment of ringworm and other skin diseases. It is soluble in acids, is not blackened by alkalies, and yields a mercurial sublimate when heated with carbonate of sodium. It is not dissolved by water, but becomes yellow by long boiling. If boiled in a solution of potash, it evolves ammonia, and yellow mercuric oxide is precipitated. It may be detected in organic fluids and solids by boiling them in one part of hydrochloric acid and four parts of water. The mercury may then be separated by means of copper.

The colour of red precipitate and the fact that when heated in a close tube it is resolved into oxygen, and mercury which is deposited in globules, are tests which serve to identify it.

Cases.—A trial for attempting to poison by white precipitate took place at the Maidstone Summer Assizes, 1869 (*R.* v. *Seaham*). The compound is white, but as a result of boiling, it gave a yellow colour to the gruel in which it was administered. In *R.* v. *Hargreaves* (Manchester Lent Ass., 1866), a girl was convicted of an attempt to poison her father by this substance. The poison was put into milk and medicine. It produced a burning sensation in the throat and stomach, and thus led to suspicion. About ten grains of white precipitate were detected in some buttermilk.

The following case is illustrative of the length of time that may elapse between taking a fatal dose of a mercurial salt and death:—At a coroner's inquest, in 1904, at Kingston-on-Thames, it was shown that the deceased had swallowed three tabloids, each containing 8·7 grains of corrosive sublimate, *i.e.*, 26·1 grains. He took them on Monday, and did not die till the following Saturday, and his death was said then to be due to syncope following on the poison.

The following case, arising from the *external application* of corrosive sublimate, is interesting. It is reported by Dr. Holloway, *B. M. J.*, 2, 1903, p. 1212. It shows some unusual symptoms, probably not due to the mercury, but to shock and fear:—

A. B., a dispenser, aged twenty-nine, dissolved 60 grains (or more) of corrosive sublimate in hot water (℥ v.) intending to make a bath for an eruption which he believed to be scabies. He sponged his arms, abdomen, thighs, and scrotum with the warm fluid, and then went to attend to people in the shop. A smart tingling came on at once, which, when he had attended to three customers, became severe pain, principally in the penis and scrotum.

When I saw him half an hour after the application the penis and scrotum were red and much swollen, and there was a papular rash on the groin and slightly on the abdomen. He was suffering very severe pain, was twitching very much, and was very jerky in his speech. I administered morphine ¼ grain and cocaine ¼ grain hypodermically, and sponged the body with flour and water and egg albumen, also administering the whites of two eggs in tea. There was difficulty in swallowing the second cup (one hour and a half after the application). At the end of another hour he was worse in every way, could hardly speak, swallowed with the greatest difficulty; the left hand was clawlike and stiff, and there were severe tremors. I gave morphine ⅓ grain. He complained of burning of his lips, throat, and stomach. Four hours later he retched violently, but with little result, and had a severe general clonic spasm lasting about twenty seconds. I sent for Dr. Bishop to assist me. The spasms recurred about every ten minutes, and did not seem to be induced by outside stimulation. Twice marked opisthotonos occurred. During the attack there was absolute general rigidity, inability to breathe at all (lasting once for ninety seconds); the pulse, which between the spasms was about 100, became running in character. There was an expression of terrible fear. A general tremor preceded each attack, with an elevation of the shoulders. Rigidity was partial during the intervals, and the breathing was very shallow and mostly abdominal. The symptoms were all at their height five hours after the application.

Two hypodermic injections of brandy ♏ xx., and morphine ⅙ grain were given. The patient was surrounded by bottles full of hot water wrapped up in bath towels wrung out of boiling water. Amyl nitrite and chloroform were administered with good result, though the shallowness of the breathing delayed it somewhat. The rigidity between the attacks diminished, but when after two hours' administration chloroform was stopped, another rather sharp, though not prolonged, spasm came on. Chloroform was then given for three more hours, and stopped nine hours after the application of the poison. The case then went on well. For two days there was a burning sensation, and one or two attacks of sickness, but there was no salivation, no suppression of urine, and no purgation. Large grey blisters covered the scrotum. There was marked weakness of the left hand, which improved every day for a week, and on the first day inability to protrude the tongue, which deviated towards the left.

The previous history probably accounts for the unusual symptoms, the patient having been wounded in the late war, and spending seven months in hospital with paralysis of the left side, from which he had completely recovered.

In the *Lancet*, 1, 1905, p. 1156, will be found an interesting case of alleged poisoning by mercury in which preservatives tended to confuse the issue.

Poisoning by Copper and its Salts.

Source and Methods of Occurrence.—All the salts of copper are poisonous. The two most commonly known in commerce are the sulphate, or blue vitriol, and the subacetate, or verdigris. The former has been frequently taken and administered in large doses, for the purpose of suicide and in attempts at murder.

In 1886 a man was convicted of attempting to murder his wife by administering to her sulphate of copper in spruce and peppermint water. He was sentenced to twenty years' penal servitude (*R.* v. *Reynolds*, C. C. C., September, 1886). In 1884 a girl was convicted of poisoning her mistress by introducing sulphate of copper into a jug of beer. The taste of the substance was perceived; the only result was severe vomiting (*R.* v. *Mary Baker*, C. C. C., October, 1884).

In the latter case the attempt has been immediately discovered, owing to the strong metallic taste possessed by the salt. This would in general render it impossible that the poison should be taken unknowingly. It has, however, been frequently given for the purpose of procuring abortion. In doses of half an ounce and upwards it acts as a powerful irritant on adults, and a much smaller quantity would suffice to destroy infants or children. There are two copper salts—the arsenite (Scheele's Green) and the aceto-arsenite (Brunswick Green)—which chiefly owe their poisonous properties to arsenic. This has been elsewhere considered. The chloride and carbonate are also irritant poisons.

With the exception of these salts, it is almost entirely in connection with the kitchen that copper poisoning now occurs, and this in two ways: (*a*) from dirty copper vessels, and (*b*) from the coppering or artificial greening of vegetables used as food. Neither of them is at all common.

As regards (*a*), it results from the experiments of Falconer and others, that metallic copper undergoes no change by contact with *water* unless the air [oxygen.—Ed.] is present, when a hydro-carbonate is formed. If the water contains an acid such as vinegar, or common salt, or if there is oily or fatty matter in contact with the metal, then the copper is more rapidly oxidised, and the liquor or fat acquires a green colour. If the **copper vessel** is kept perfectly clean, and the food prepared in it is allowed to cool in other vessels, there is not much risk of its acquiring a poisonous impregnation; nevertheless, no acid, saline, fatty, or oily liquid should be prepared as an article of food in a copper vessel. Under the influence of heat and oxygen, a portion of copper becomes dissolved, and the oily or other liquid acquires a green colour. The preparation of fruits, such as preserves, in copper vessels is necessarily attended with some risk, for on cooling a green crust is apt to form on the copper, just above the surface where the air and acid liquid meet. Some liquids, while boiling, appear to be little liable to this impregnation; thus, coffee, beer, milk, and tea have been separately boiled for two hours together, in a clean copper vessel, without any portion of the metal being taken up by either of the liquids. Accidents of this kind are usually prevented by lining the copper vessel with tin, or by using vessels of silver; but in very large boilers this plan is not always adopted; cleanliness alone is trusted to, and this, when properly observed, is a sufficient preventive. In reference to culinary vessels the tin is often worn away, and the corroded copper is thus exposed to the action of any acids contained in the food.

In 1866 some rhubarb-stems were stewed in an imperfectly tinned and dirty copper vessel, and were supplied to a family for dinner. The children and their governess partook of it—the latter very freely. All were taken ill. The governess suffered most; there was violent sickness, and other symptoms of irritation. She partially recovered under treatment, but had a relapse, and died from the effects of the poisoned food.

The oxalic and malic acids in the vegetables probably acted strongly on the copper in the presence of oxygen.

Waldemann published a paper on the effects of copper and zinc, and their alloy brass, when used for culinary utensils (Horn's *Vierteljahrsschr.*, 1870, 1, 247).

The tin used for lining copper vessels is frequently alloyed with a large proportion of lead, and thus lead-poisoning may be substituted for poisoning with copper. According to Paasch, many of the accidents attributed to this form of copper-poisoning are really due to other causes (Casper's *Vierteljahrsschr.*, 1852, B. i. H. i. S. 78). It has been elsewhere stated that all the ordinary copper employed for culinary utensils contains arsenic. In those cases in which the metal is converted into insoluble oxides or salts by acid or fat the arsenic may be found in an insoluble form in the green incrustation produced. When copper thus forms an insoluble salt, arsenic is not dissolved.

As regards (*b*), in the **making of preserved fruits and vegetables,** the salts of copper (blue vitriol) are used for the purpose of giving a rich green colour. Many of the green pickles sold in shops were formerly thus impregnated with the vegetable salts of this metal, to which they owed their bright grass-green colour. Only a portion of the copper is in a soluble form. The quantity of copper contained in such articles may not be sufficient to cause fatal effects; but serious symptoms of gastric irritation are sometimes produced, and in young persons these may assume an alarming character. The restrictions on the exportation of green peas coloured with copper from France have been relaxed, and coppered peas are again an article of commerce in the British Isles.

According to Tschirch the practice with some manufacturers is to treat the green vegetables with a dilute solution of sulphate of copper, and afterwards wash them thoroughly with water before boiling. The result is the formation in the plant tissue of phyllocyanate of copper, a compound containing 7·35 per cent. of copper, insoluble in water, dilute hydrochloric acid, or acetic acid, but soluble in alcohol. The tinctorial power of this compound is said to be comparable to that of eosine, very great, and the colour is unaltered by light. Considering that copper itself is not an active poison, and that this compound contains it in so small proportion and in so insoluble a form, Tschirch expressed the opinion that this treatment of preserved vegetables might be allowed. Kobert, on the other hand, stated it was true that a large dose of a copper salt might be taken at one time without producing toxic effects, but it had not been proved that a continuous administration would not produce chronic poisoning. Moreover, although it might not be convenient to produce green preserved peas without the use of copper, it was by no means necessary that peas should be green in order to be eaten (*Pharm. Jour.*, Nov. 7, 1891, p. 366).

Charteris and Snodgrass show that by digesting coppered peas in dilute hydrochloric acid some copper is dissolved. By digesting the peas with a mixture of pepsin and dilute hydrochloric acid, copper was dissolved to the extent of 0·52 grain per pound of peas, equal to 2·05 grains of sulphate of copper. Artificially prepared compounds of copper with albumen and with casein were also submitted to the action of solutions containing respectively pepsin with hydrochloric acid and pancreatin with carbonate of sodium, the temperature being maintained at 99° Fahr. It is stated that at the end of an hour and ten minutes digestion was complete in the acid solution in the case of the albumen compound, and at the end of two hours in the alkaline solution; in the case of the casein compound, digestion was complete at the end of two hours in the acid solution, and at the end of one hour in the alkaline solution. Rabbits and pigs were supplied with food containing an admixture of albuminate of copper or sulphate of copper, and when the animals were killed copper was found in their liver and kidneys. When the quantity of sulphate of copper given to a young pig weighing nine pounds amounted to 60 grains, it refused the food for twenty-four hours, but it readily took food containing 10 grains, and continued to do so for four days, when it was killed.

It has been stated that an impure gold alloy used by some dentists has been so largely composed of copper as to affect the health of those who have used the plates for the support of artificial teeth. The acid and salts in the saliva facilitate the production of a poisonous salt of copper.

The editor is unable to find any corroboration of this statement.

Toxicity and Fatal Dose.—The ordinary pharmacopœial dose of the sulphate for emetic purposes is five to ten grains.

There are but few instances in which the sulphate has proved fatal in the human subject, so that but little is known of the fatal dose. One fatal case was recorded in England in 1891. In 1836, a girl, sixteen months old, put some pieces of *Blue-stone* (sulphate of copper), which were given to her to play with, into her mouth. In a quarter of an hour the child vomited a bluish-green coloured matter, with pieces of sulphate of copper in it; the skin was alternately cold and hot, but there was no purging. The child died in *four hours*, without being convulsed, but it was insensible before death (*Med. Gaz.*, vol. 18, p. 742). Unfortunately no inspection of the body was made.

A woman who swallowed *two ounces* of verdigris died in three days: in addition to the symptoms described below, there were convulsions and paralysis before death. Niemann relates that a female, aged twenty-four, swallowed *half an ounce* of verdigris, and died under symptoms of severe irritation of the stomach in sixty hours ("Taschenbuch," p. 458). In consequence of the great uncertainty of its operation, subacetate of copper is not employed internally.

Duration.—As with all irritants, the symptoms ensue within a quarter of an hour, or less, of taking the poison; but exceptionally from the condition of the contents of stomach, they may not appear for three or four hours or longer. It may be, too, that the insolubility of the copper salt in tinned vegetables may delay the symptoms, for in these cases the symptoms are usually some time in appearing.

If a fatal result ensue it is commonly some hours after taking the poison, *vide* above.

Symptoms.—The sulphate speedily causes violent vomiting, for which purpose it is sometimes used. If the dose has been excessive, in addition to the vomiting, there is headache, pain in the abdomen, with purging; the pain is of a colicky character; and in aggravated cases, there are spasms of the extremities and convulsions. Percival met with an instance in which violent convulsions were produced in a young woman by 120 grains of sulphate of copper. Paralysis, insensibility, and even tetanus, have preceded death, when the poison was administered to animals. Among the symptoms casually met with in the human subject, may be mentioned jaundice. This has been observed to attend poisoning by the sulphate, as well as by Scheele's Green.

Verdigris produces symptoms somewhat similar to those caused by the sulphate. There is a strong styptic metallic taste, with a sense of constriction in the throat, followed by severe colicky pains, vomiting of a green-coloured liquid, and purging, with violent straining (tenesmus).

Chronic poisoning by copper is occasionally seen among workers in this metal and its salts. The poison enters the system partly by the lungs in the form of dust, and partly by the skin in handling the metal or its salts. The marked symptoms are a coppery taste in the mouth, giddiness, pain in the bowels, vomiting, occasional diarrhœa, and wasting of the body. Clapton has pointed out another symptom, namely, a green line on the margin of the gums. He met with this in a sailor and in some working coppersmiths (*Med. Times and Gaz.*, 1868, 1, p. 658). The green line was well marked, and this was shown by tests to be owing to copper. The perspiration from the hands in working had converted the copper into basic chloride, and thus led to its absorption by the skin. Several cases of chronic poisoning by copper among coppersmiths have been treated by Cameron, but this symptom was not noticed (*Med. Times and Gaz.*, 1870, 1, p. 581).

The existence of chronic copper poisoning is not doubted by the majority of authorities on toxicology; but it must be admitted that much has been alleged as to this form of disease which is open to question. The fact that the majority of workers in copper and its compounds remain perfectly healthy is not conclusive as to the innocuous character of the metal, spite of the assertions of Galippe (*Etude Toxicol, sur le Cuivre*, Paris, 1875). Oppolzer asserts that he has seen a case of copper paralysis affecting the right arm, and very similar to lead paralysis (Ziemssen's "Cyclop. of Med.," vol. xvii. p. 593).

The editor leaves these remarks without comment, except that when the case mentioned on p. 456 was tried, no one in court could produce any evidence of any genuine chronic case having occurred, comparable, let us say, in the remotest degree with lead or mercury.

At the same time it must be admitted that the disease known as brassfounders' ague has a very definite existence; brass is an alloy of zinc and copper, and it is doubtful to which element the disease must be ascribed (*vide B. M. J.*, 1, 1900, in an article by Dr. Wm. Murray, also *B. M. J.*, 2, 1901, p. 405).

Treatment.—This can be on general principles only, *vide* p. 334.

Post-mortem Appearances.—In poisoning with the salts of copper, the mucous membrane of the stomach and intestines has been found more or less thickened and inflamed, in the few fatal cases which have been hitherto examined; the membrane has been also found destroyed and softened in poisoning with verdigris. The gullet has presented an inflamed appearance. In a case of poisoning with verdigris quoted by Orfila, the stomach was inflamed and thickened, especially towards the intestinal opening, the orifice of which, owing to the general thickening, was almost obliterated. The small intestines were throughout inflamed, and perforation had taken place, so that part of the green liquid was effused into the abdomen. The large intestines were distended in some parts and contracted in others, and the rectum was ulcerated on its inner surface. The lining membrane of the intestines has been found throughout of a deep green colour, owing to small particles of verdigris adhering to it. It has been said that this is an uncertain character of poisoning by copper, since a morbid state of the bile often gives a similar colour to the mucous membrane of the stomach and duodenum. This objection cannot apply when the green colour is found in the gullet and throughout the intestines; and, under any circumstances, the evidence from the presence of a green colour would amount to nothing in the judgment of a prudent witness unless copper were freely detected in the parts so coloured. The green stain, if due to copper, will be turned blue by ammonia.

Analysis.—Whatever doubt may exist with regard to a green colour of the tissues, the colouring of the vomit is certainly a point of value. The *vomited* matters are remarkable for being generally of a *blue* or *green* colour; and broken crystals of the blue vitriol were discovered in them in a case in which the poison was taken in a loosely pulverulent state. If the green colour of the vomited liquids is owing to altered bile, it will not acquire a blue tint on adding to a portion of the green liquid a solution of ammonia; but if it be caused by a salt of copper, this change of colour will serve to indicate the fact.

The salts of copper are generally known by their colour; whether in the solid state or in solution, they are either blue or green. The salts of one other metal are also of a green colour, namely, nickel; but there are striking chemical differences between the salts of this metal and those of copper. There are *three* very *soluble* salts of copper; two of these are blue, the sulphate and nitrate, and one green, the chloride. The solutions of the copper salts have generally an acid reaction. The salt should be dissolved in water, diluted, and the following tests may then be applied:—

Tests.—(1) *Solution of ammonia* gives a bluish white precipitate, which is soluble in an excess of the test, forming a deep violet-blue liquid. (2) *Ferrocyanide of potassium* gives a rich claret-red precipitate; if the quantity of copper is small, the liquid acquires merely a light red colour; if large, the precipitate is of a deep red-brown colour, and of a gelatinous consistency. Ferrocyanide of potassium will act on the violet-blue solution produced by ammonia, provided acetic acid is added to neutralise the ammonia. One portion of the liquid may thus be tried by the two tests. (3) *Sulphuretted hydrogen gas*, or sulphide of ammonium, gives an almost black precipitate, even in an acid solution, or, if the copper is in small proportion, merely a reddish brown colour. (4) A slip of *polished iron* (a common needle), suspended by a thread in the liquid, slightly acidulated with sulphuric acid, is speedily coated with a layer of copper, even when the salt is present in very small proportion. If the needle is left for some days in the liquid, the iron will be slowly removed, and a hollow cylinder of metallic copper will remain. This may be washed, dissolved in dilute nitric acid, and tested with the foregoing tests; or the iron, coated with copper, may be at once partially immersed in ammonia and exposed to air. The liquid then becomes slowly blue. Half a grain of sulphate of copper, dissolved in sixteen ounces of water, may be thus easily detected. The blue solution, acidified with acetic acid, gives a red colour or precipitate with ferrocyanide of potassium. (5) *The Electrolytic Test.*—If a few drops of the copper solution are placed on platinum foil, slightly acidulated with a diluted acid, and the platinum is then touched through the solution with a slip of zinc, metallic copper, of its well-known red colour, is immediately deposited on the platinum. When the quantity of copper is small, there is merely a brown stain; but a blue liquid is formed by pouring on it ammonia, and exposing it to air. The blue liquid may be further tested with ferrocyanide of potassium after acidification with acetic acid.

Commercial sulphate of copper sometimes contains *traces of arsenic.* Ten grains of the crystallised sulphate will occasionally be sufficient to yield evidence of the presence of arsenic. When the sulphate has been given as an emetic, traces of arsenic may sometimes be found in the contents of the stomach or in the matters vomited.

Copper in Organic Liquids.—The copper is liable to be precipitated by certain organic substances, *e.g.*, albumen, fibrin, casein, and mucous membrane; but some of these organic compounds are easily dissolved by acids, or even by an excess of the solution of copper salt. A portion at least of the salt of copper is, therefore, commonly held dissolved. In such cases there is one peculiar character possessed by these liquids; *i.e.*, they have a decidedly *green colour*, even when the copper salt is in a far less than poisonous proportion.

A polished needle, or a fine iron wire, may be used in these liquids as a trial test for the presence of the salts of copper. This test is a very delicate one to use for pickles and bottled vegetables. If in large quantity, the copper may be precipitated by sulphuretted hydrogen, the sulphide collected, dried, and converted into the soluble sulphate by the action of strong nitric acid. If in small quantity, the following is the most expeditious method of obtaining copper from any organic liquid which contains a soluble poisonous salt of this metal. Having added a few drops of diluted sulphuric acid, and filtered the liquid, let a portion of it be placed in a platinum capsule or crucible, and a slip of zinc introduced. Wherever the platinum is touched by the zinc, metallic copper of its ordinary red colour is deposited; and, after having in this way coated the platinum capsule, the surplus liquid may be poured off, and the capsule well washed with water. The copper is then dissolved in nitric acid, and the tests may be applied to the solution after the excess of acid has been driven off by heat. In place of nitric acid and heat, a strong solution of ammonia may be used in the cold. Under exposure to air the metal is oxidised and dissolved in a few minutes, forming a blue solution. The ammoniacal solution may be neutralised with diluted acetic acid, and ferrocyanide of potassium then added. The red colour of the metal deposited on platinum is characteristic of copper; but should any doubt exist, this may be removed by placing a polished needle in the ammoniacal solution, and adding diluted acetic acid to neutralise it. The needle is immediately covered with a red layer of copper. Not much importance should be attached to the discovery of mere traces of this metal either in the body or in articles of food. Copper, if looked for, may be found in many cases in the tissues and in food under circumstances quite unconnected with poisoning (Guy's Hosp. Rep., 1858, p. 103).

In the Tissues or Urine.—Dry and incinerate the organic matter, using an iron burner, digest the residue in warm nitric acid, and then evaporate to dryness. The residue may be dissolved in a small quantity of water, and a polished needle immersed in it for some hours. The metallic deposit, if any, on the needle, may be recognised as copper either by its colour or by the action of ammonia.

Copper is believed by some observers to be nearly always present in the liver of man. Dupré found in human livers about one part of copper in 500,000; and in fourteen bodies examined by Bergeron and Hote copper in minute quantities was found in every case. It is also believed to occur normally in very small quantities in the kidneys and in the blood. The copper is probably mainly derived from the grains of cereals, such as wheat and barley; in turnips, and most other vegetables, copper in very minute traces may generally be detected. It has been suggested by Johnstone that the presence of copper in cereals may be due to the practice of dressing the grain, and also the ground, with sulphate of copper, with the object of protecting it from the ravages of vermin after the grain is sown (Luff).

Cases.—The following, taken from the *Lancet*, 2, 1901, p. 622, shows a new danger:—

"Toxicologists will have to note that there is another risk of poisoning by sulphate of copper than those hitherto commonly recognised, and that is through the spraying of potatoes to prevent 'potato blight.' It appears from the evidence given at an inquest held in Ballymena on August 23rd that a farm labourer was working on a farm on August 19th and 20th. He had a spraying machine strapped on his back and was spraying potatoes. On the 19th he complained before dinner of being sick; on the 20th he went home, partook of some supper (potatoes) at seven o'clock, and retired to rest between nine and ten o'clock. In the early morning he was taken severely ill, and Mr. Alexander Duncan, of Ballymena, who saw him at 4.30 a.m. on the morning of the 21st, found him suffering from severe cramps all through his limbs and body, his heart failing, and his body covered with free perspiration. He died at about two o'clock in the afternoon of the 21st. He had a fresh wound on his hand, which was perfectly blue with the 'bluestone,' which was chiefly sulphate of copper. Mr. Duncan said that if there were scratches on the hands of the person engaged in spraying potatoes, or if the person inhaled the spray, it might possibly produce the collapse. His evidence was that deceased had died from collapse following irritant poisoning. Dr. A. McN. D'Evelyn, of Ballymena, who also saw the deceased, agreed with Mr. Duncan as to the cause of death, and said that to take food without washing the hands after being engaged with a spraying machine was extremely dangerous, and he believed, as it was a hot day, that in breathing in the fine vapour of the spray a considerable quantity of poison might have been absorbed. The jury, after recording that the deceased died 'from collapse following upon irritant poison,' possibly through the absorption of the mixture sulphate of copper, used in the spraying machine which he carried and used on August 19th and 21st, added a rider that the evidence brought out by Mr. Duncan and Dr. D'Evelyn ought to be a warning to farmers and farm-servants not to engage in spraying potatoes with lacerated hands, or to blow down the pipe of a sprayer, or to take food without washing their hands thoroughly, as any of these practices is extremely dangerous, the bluestone used being an irritant poison. It is possible that the wearing of gloves or long gauntlets and a respirator might be a useful preventive."

In 1866 a remarkable set of cases occurred in a family at Itchon Abbas, Hants, in which twelve or more members of the family suffered from symptoms of poisoning similar to those produced by copper. A badly tinned copper vessel had been used for cooking the food, with much salt. One patient, an old man, æt. 90, died after three weeks, the others recovered. The cook was charged with wilful poisoning, but was subsequently liberated. She brought an action against her master (*Tully* v. *Corrie*, Queen's Bench, November, 1867), but this resulted in a verdict for the defendant (Guy's Hosp. Rep., 1866, p. 329). A set of cases is reported to have occurred at Geneva, in 1870, in which ten persons were taken ill with symptoms of irritant poisoning, and four died. It was found that the food had been cooked in a copper utensil containing a large quantity of verdigris (*Pharm. Jour.*, August, 1870, p. 158). A fatal case of poisoning by copper is reported in the same journal for 1870, p. 874. Copper was found in small quantity in the body.

Poisoning by Gold Salts.

Source.—The *Terchloride* is the only preparation of gold which requires notice. It is a powerful irritant poison, acting locally like nitrate of silver. Little is known of its poisonous effects on man; but, in administering it to animals, Orfila found that it caused extensive inflammation, and even ulceration, of the mucous membrane of the stomach ("Toxicologie"). The metal is absorbed and carried into the tissues, but its poisonous action appears to be independent of absorption.

Case.—In October, 1893, a case of poisoning by chloride of gold was admitted to Guy's Hospital, of which the following is an abstract:—

The victim was a boy of six, admitted under Dr. Hale White on October 22nd, 1893, about 11 p.m. He had swallowed the contents of a small glass tube found on a dustheap. He was sick immediately afterwards, the first vomit being black in colour. The vomiting persisted, and he was admitted to the hospital at 2 a.m., much collapsed, eyes closed, face pallid and cold, the lips, tongue, teeth, stained of a purplish colour. The fauces were injected, but not stained; the fingers were stained. Pulse extremely feeble. Within ten minutes the bowels acted twice. At 10 a.m. the vomiting still continued, and diarrhœa was present. The child did not seem to be in pain, but the epigastrium was tender on pressure. He had by this time rallied considerably from shock. There was noticed a black stain on the teeth. About 5 p.m. on the day of admission the vomiting and diarrhœa ceased, and he was discharged well about twelve days after admission. Pupils natural and no unconciousness throughout.

Sir Thomas Stevenson reported that the tube was one used by photographers for toning; it was made to contain 15 grains. Of this 2·6 grains were found in the tube, leaving 12·4 grains either swallowed or lost. He found traces of gold in the fæces and vomit, but none in the urine.

Poisoning by Preparations of Thallium.

The salts of this metal are, according to Paulet, highly poisonous, although this does not appear either from his own statement of their effects or from the experiments of Lamy. Paulet found that a dose of fifteen grains of carbonate of thallium killed a rabbit in a few hours. The animal suffered from disturbance of breathing, loss of muscular power, and general trembling of the limbs; it appeared to die asphyxiated. The salts of this metal have been found to operate through the skin by absorption.

Lamy dissolved seventy-seven grains of the sulphate in milk, and he found that this quantity sufficed to destroy two hens, six ducks, two puppies, and a middle-sized bitch. The prominent symptoms in the dogs were oppression of breathing, salivation, griping pains in the abdomen, the body being drawn up, with trembling and convulsions of the limbs, followed by paralysis. Vomiting and purging are not described among the symptoms. The two puppies did not die until four days after they had taken the poison. On opening the bodies of the animals Lamy states that there was no mark of inflammation or other striking post-mortem appearance. In one experiment he found that a puppy died in forty hours from a dose of one grain and a half of sulphate of thallium (*Chem. News*, September 12th and 19th, 1863).

The salts are soluble, colourless, and nearly tasteless; and therefore may be easily administered.

These statements of Lamy and Paulet are not in accordance with the views of Crookes, the discoverer of the metal. Although much exposed to the action of the fumes, the metallic vapour produced no particular effects upon him. He also swallowed a grain or two of the salts without injury. These have a local action on the hair and skin, staining the former, and rendering the latter yellow and horny (*Chem. News*, October 3rd, 1863, p. 161).

Maumé and Rabuteau state that thallium is at once both a cardiac and a muscular poison, in its action resembling mercury in one respect and potassium in another. The history of thallium as a poison is incomplete.

Analysis.—The best and most certain method of detecting thallium is to try and burn the viscera, when, by the aid of the spectroscope, the green band indicative of thallium will manifest itself in the spectrum from the smallest quantity of the metal, in spite of admixture with other bodies.

Poisoning by Salts of Tin.

Source and Method of Occurrence.—The only preparations of this metal which require to be noticed as poisons are the *chlorides*, or *muriates*, a mixture of which is extensively used in the arts, under the name of *Dyers' Spirit*. The salts may exist in the form of whitish yellow crystals; but more commonly they are met with in a strongly acid solution in water. They are irritant poisons, but so seldom used as such, that only one death occurred from them in England and Wales during a period of two years.

Small quantities of tin are not uncommonly taken in articles of tinned food, and in Demerara sugar prepared by what is known as the "Bloomer process," in which a solution of stannous chloride is employed. Such sugar contains about half or one-third of a grain of tin per pound. According to Sir Thomas Stevenson's experiments, neither dogs fed on such sugar nor persons who habitually consume such sugar as an article of daily diet suffer in health. Others consider the tin to be injurious to health. Luff has described four cases of tin poisoning caused by tinned cherries. The syrup of the cherries contained 1·9 grain of the higher oxide of tin in each fluid ounce (*B. M. J.*, 1890, 1, p. 833).

Toxicity and Fatal Dose.—The following is Dr. Luff's own account of the cases referred to above, and one other from the *Med. Press and Circ.*, 1894 :—

"In four cases of tin poisoning, caused by tinned cherries, that were seen and described by the author and Metcalfe, an estimation of the amount of tin present in the cherry-juice was made, as the tin from which the patients had taken the cherries was left half full of cherries and juice, and therefore was available for purposes of analysis. The juice was strongly acid, and the analysis showed that the acidity was mainly due to malic acid; the juice contained tin in solution equal to 1·9 grain of the higher oxide of tin in each fluid ounce, which would be equal to 3·2 grains of the malate of tin in the same quantity of juice. The symptoms of these cases were very severe, there being a considerable amount of collapse and cyanosis and in one case unconsciousness; it was estimated that the symptoms were produced by doses of the malate of tin varying from four to ten grains. All the cases recovered.

"A peculiar case is recorded in which a chemist died from tin poisoning. He had inadvertently filled his pepper caster with putty powder, which is the higher oxide of tin, and had continued to use it until he fell ill a couple of months afterwards and ultimately died."

Symptoms.—Nausea, abdominal pain, vomiting, and diarrhœa were observed in the above cases. There was much depression, with feeble pulse and drowsiness, and in one case at least extreme collapse. Dr. Humphreys, who attended one of the cases, says that cramps in the legs were most marked, and that he vomited a little blood.

Analysis.—Dr. Luff gives the following :—

"Tin may be separated from organic admixture by destroying organic matter by the moist method (see p. 354). The clear fluid, which contains *stannic* chloride, may be submitted to the following tests :—

"1. Sulphuretted hydrogen gives with a solution of a stannous salt a brown precipitate of stannous sulphide, and with a solution of a stannic salt a yellow precipitate of stannic sulphide.

"2. Stannous chloride added to a solution of mercuric chloride first reduces it to the mercurous state, throwing down a white precipitate of calomel, and subsequently reduces this to the metallic state, producing a grey precipitate, due to the formation of finely divided mercury.

"3. With gold chloride stannous chloride gives a purple precipitate" (*vide* also tests for zinc).

From the solution of stannic chloride the metal is deposited on zinc by zinc-platinum couple, and on dissolving the zinc deposit in boiling HCl a solution of stannous chloride is obtained suitable for the tests quoted.

POISONING BY LEAD AND ITS SALTS.

Source and Method of Occurrence.—Next to iron lead is, perhaps, the most useful metal known, and is mined in enormous quantities. In the actual mining operations there would seem to be but little danger; it is in the manufacture and uses of lead salts for commercial purposes and in the contamination of water supplies that cases of lead poisoning chiefly occur.

The following are the preparations of lead deserving of individual notice here, though it must be stated that there is not a single compound into which lead enters that is not capable of doing mischief:—

1. The metal itself.
2. Sugar of lead or the acetate.
3. White lead, carbonate or oxycarbonate.
4. Oxides of lead.
5. Other salts.

As showing the improvement in our national health and care in dangerous occupations, Sir Thomas Stevenson stated in the previous edition of this work in 1894 that no less than 132 fatal cases of lead poisoning were recorded in 1891 in England and Wales, whereas in 1901 only one solitary case is tabulated by the Registrar-General.

1. **Lead Itself.**—Of this it is difficult to speak positively, because in most of the cases to be mentioned it is absorbed as an oxide or carbonate or some other salt; but there are some few illustrations of poisoning by the metal itself, which has then in the body undergone a change into a salt of lead.

A tea-dealer was seized with symptoms of lead poisoning, and the cause remained long unsuspected, until he admitted that, in course of his trade, he had the idle habit of often placing pieces of tea-lead in his mouth, and crushing the metal between his teeth.

Sonnenkalb considered that snuff frequently acquires an impregnation of lead by reason of the coverings of lead in which it is packed. He collected nineteen cases of this form of chronic poisoning; in fourteen of these there was paralysis, and in five there were symptoms of gastric disturbance. The arms were most commonly affected with paralysis and wasting of the extensor muscles. In twelve cases there was a blue colour of the gums. All suffered from colicky pains and constipation. The poisoned snuff had been used for a period of from six months to twenty years; and on leaving it off the patients improved rapidly, and eventually recovered.

2. **Sugar of Lead or the Acetate.**—This is more frequently taken as a poison than any of the other salts of the metal, although cases of acute poisoning by lead in any form are not common. The substance is met with in solid heavy crystalline masses, white or of a brownish white colour; it resembles loaf sugar in appearance, and has often been mistaken for it. It has also a sweet, followed by an astringent or metallic taste. It is very soluble in water, four parts of distilled water at 60° Fahr. dissolving one part; and it is much more soluble at a boiling temperature.

A remarkable series of cases of poisoning by acetate of lead has been reported (*Lancet*, 1849, 1, p. 478). By some accident, about thirty pounds of this substance were mixed at a miller's with eighty sacks of flour, and the whole was made into bread by the bakers and supplied as usual to their customers. It seems that no fewer than 500 persons were attacked with symptoms of poisoning after partaking of this bread.

Liquids used for culinary or dietetic purposes, especially if they contain a free *acid*, are liable to become impregnated with lead, derived from the glaze of the vessel in which they are kept, and thus form poisonous salts. If vinegar is used, acetate of lead may result.

Litharge-glaze is also easily dissolved by alkaline or *fatty* substances. The eating of dripping, or the fat of meat baked in a newly glazed vessel, has been known to give rise to a slight attack of colic; while the symptoms were referred by the person to some substance mixed with the food. (For cases see *Med. Gaz.*, vol. 47, p. 659; also *Lancet*, 1860, 1, p. 962.) In 1852, four men partook of rhubarb-pie and milk for supper. Shortly afterwards they were all seized with violent vomiting and intense colic. Lead was detected in a portion of the vomited matters and food. The only source to which the lead could be traced was the glaze of the pans in which the milk was kept.

The acetate in solution as liquor plumbi subacetatis is largely used in medicine as a lotion, and from this solution as a basis many proprietary remedies are made of the class of hair-dyes, washes, etc. Of such Goulard extract or water is an example, which has caused death in at least four instances, one in France and three in England.

In the *B. M. J.*, 1, 1898, p. 491, is reported a case of severe plumbism from washing out the nose with a lotion containing "a pennyworth of sugar of lead to the half-pint of water." This washing had been done two or three times a day for some months.

3. **White Lead.**—It is this salt that is responsible for the majority of cases of lead poisoning occurring amongst workmen, inasmuch as it is the basis from which practically all lead pigments and glazes are obtained.

One cause of lead-palsy among infants may be the use of farinaceous food wrapped in lead-foil having a thinly tinned surface, sold as patent tin-foil. Such infants' food is sometimes strongly impregnated on the outside with carbonate of lead. Snuff and tobacco, chocolate, and other substances in ordinary use are frequently wrapped in this spurious tin-foil. If the articles are kept in a damp place, they may thus become impregnated with carbonate of lead.

White lead is sometimes contained in small proportions in loaf sugar, owing to the moulds in which the sugar is set being painted with white lead, and a portion being thus mechanically taken up.

Lacy has pointed out the injury to health which is likely to follow the use of white lead as a cosmetic by actors. The glazed white leather lining of hats is strongly impregnated with carbonate of lead, which may penetrate the body by the perspiring skin.

4. **Oxides of Lead.**—The yellow oxide (massicot) and the puce-coloured oxide (peroxide) are but little known, except to chemists. *Litharge* and minium or *red lead* are, however, much employed in the arts, and have sometimes given rise to accidental poisoning. A woman who had swallowed two and a quarter ounces of red lead was admitted into hospital. No symptoms appeared for nine hours. There was then colicky pain, with urgent vomiting, followed by headache and general tenderness of the abdomen. She entirely recovered in about twelve days (Guy's Hosp. Rep., 1850, p. 209). In March, 1870, owing to an accident, some red lead became mixed with a quantity of beer at a brewery at Guildford. Several persons who drank this beer suffered from lead poisoning. One man died, but it was probable that disease of the lungs was the immediate cause of death. Colicky pains, a blue line on the gums, and constipation, were well-marked symptoms

among the patients. In the course of a month as many as twenty-seven cases of lead colic came under treatment (*Lancet*, 1870, 1, pp. 428 and 495). A fatal case of poisoning by red lead has been recorded ("Report of Calcutta Med. Soc.," July 13th, 1881). The woman died within five hours. The symptoms were pains and convulsions. The only noticeable appearance met with in the body was, it is said, corrosion of the stomach.

For cases of lead plaster being used as an abortifacient, *vide* under Abortion, p. 167.

5. **Other Salts.**—This group is meant to include all those cases in which the lead gains access to the body by what may be called domestic routes. It includes some of the above salts, undoubtedly; but often, and especially in water and beer, it may be doubtful what special salt is present.

Cosmetics and hair-dyes containing preparations of lead, commonly called hair-restorers, may also produce dangerous effects. The author met with an instance in which paralysis of the muscles on one side of the neck arose from the imprudent use of a hair-dye containing litharge. These hair-dyes or "hair-restorers" are sometimes solutions of acetate of lead of variable strength in perfumed and coloured water. In other cases they consist of hyposulphite of lead dissolved in an excess of hyposulphite of sodium. In one instance the continued use of such a dye is reported to have proved fatal, and lead was found in the liver and one of the kidneys (*Pharm. Jour.*, 1869, 1, p. 304; also January, 1869, p. 440).

Besides the workers in lead factories, plumbers, painters, workers on gas and water pipes, printers (types), potters (glazing with lead glaze), weavers (lead weights on looms), file-makers (striking files on leaden cushions), enamel workers, and others are liable to suffer from chronic lead poisoning. The use of cosmetics containing lead, the use of lead-glazed crockery, the taking of snuff adulterated with oxides of lead, and the use of aerated beverages and drinking water which has been allowed to remain in contact with lead, are all recognised sources of lead poisoning. In one remarkable case a proof-reader was poisoned by reading printed proofs for many years. Type-metal is an alloy of which lead is a preponderating constituent.

Cider is sometimes poisoned with lead owing to the use of leaden vessels or pipes in its manufacture. An instance of the fatal effects of cider so poisoned is reported to have occurred in Worcestershire in 1864, and another fatal case occurred in Herefordshire in 1867. Eight men were seized with symptoms of lead poisoning, and one died. Herapath found one grain of lead in a gallon of cider. The leaden pipe was found corroded by the acid in the cider. Lead pipes are largely used by publicans for the supply of beer. It is possible, therefore, if the beer is acid, and is allowed to remain some time in the pipe, the first portions drawn may acquire an impregnation of lead, which may give rise to colic and other unpleasant symptoms. This is a not infrequent though unsuspected cause of lead poisoning in potmen. Common acetic acid has been known to contain, as impurity, 2 per cent. of acetate of lead. Lead is also found in citric and tartaric acids, aerated beverages, Seidlitz powders, and in salts which have been crystallised in leaden pans. Litharge was formerly much used to remove the acidity of sour *wine*, and to convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; the adulteration was discovered by Fourcroy, and it was immediately suppressed. Wine thus poisoned is known by its being blackened by sulphuretted hydrogen.

Snuff has been adulterated with red lead in order to improve its colour. Two instances of chronic poisoning by lead came under the author's and one under Sir Thomas Stevenson's notice as a result of the presence of oxide of lead in snuff. One example contained the oxide in large proportion. This noxious adulteration has frequently given rise to paralysis and other forms of lead disease. In another work (" On Poisons," 2nd ed. p. 485) the author has referred to cases in which colic and paralysis have occurred in persons who have slept in newly painted rooms. Alderson mentions several instances of this kind (*Lancet*, 1852, 2, p. 391). The author suffered from a severe attack of colic as a result of sitting in a room for a few hours a day in which a large surface of canvas for an oil-painting had been covered with white lead and drying oil. An officer, æt. 50, fond of painting in oil-colours, worked for some time in a room eight feet square which had a large stove in it. He was attacked with wristdrop (paralysis) in December, 1855, and soon afterwards with paralysis in both legs. It appears that his servant always ground his colours, mixed them, and cleaned his brushes. The officer had experienced an attack some years before; but from this, by laying aside oil-painting, he completely recovered. In these instances, the emanations of lead appeared to have been received through the lungs. The symptoms were of the character peculiar to lead poisoning, and as they disappeared on the removal of the patient to another atmosphere, there could be no doubt about the cause. These insidious effects of lead should be borne in mind by those who deny that any noxious emanations can escape from papers in inhabited rooms merely because the greater number of persons who live in them do not suffer. Among white lead manufacturers the carbonate finds its way into the system either by the skin, the lungs, mouth, and nostrils, or all these channels together; it is diffused in a fine powder through the atmosphere, and thus enters into the lungs. It has been remarked that, in manufactories where the powder was ground dry, not only have the labourers suffered, but horses, dogs, and even rats, have died from its effects. The rats have been affected with paralysis in their hind legs. Since the practice has arisen of grinding the carbonate of lead in water cases of lead colic have not been so numerous. Fatal instances of this kind of poisoning have been frequently reported (Oliver on "Lead Poisoning," 1891).

Men employed in the manufacture of pottery or glazed cards are liable to attacks of this kind. There are numerous other cases in which lead or its preparations, by mere contact with the skin, have been known to produce the usual results of lead poisoning. An infant was paralysed by reason of its having been washed every morning with water containing a finely diffused oxycarbonate of lead. A man suffered from lead-palsy; he had been a potman, and the palsy was attributed to the constant handling and cleaning of pewter pots (*Med.*

Gaz., vol. 48, p. 1047. For another case see *Lancet*, 1860, 1, p. 60). A case of lead poisoning was traced to the handling of vulcanised rubber impregnated with lead. The man was a trunk-maker, and used this material in his trade (*Pharm. Jour.*, 1870, p. 426). The mere handling of lead or its compounds is therefore sufficient to produce all the effects of chronic poisoning.

The occurrence and prevention of lead poisoning from water and from potteries and glazing processes has of late years become too strictly a province of hygiene to be at all fully discussed here. For further details the reader is referred to a report presented in February, 1899, by Professor T. E. Thorpe, of the Government laboratory, London, and Professor Thomas Oliver, of Newcastle-on-Tyne, to the Home Secretary, on the employment of compounds of lead in pottery manufacture. During the three years previous to the report 1,085 cases of plumbism had been notified to the Chief Inspector of Factories. The *B. M. J.* (2, 1903, p. 1659) thus comments on the report:—

> "It is unnecessary to recapitulate the various points dealt with in the Thorpe-Oliver report, but, briefly, their conclusions were that a very large amount of earthenware could be glazed without the use of lead in any form; that as regards certain branches of the industry, while the need for using lead was admitted, insoluble lead compounds could be used, such as fritted double silicates; that the use of raw lead should be prohibited, women and young persons excluded from the dangerous processes; and that adult males working in dangerous processes should be subjected to systematic medical examination. This report, it may be remembered, gave rise to a good deal of opposition on the part of the manufacturers. Although compromises were subsequently attempted, no solution of the various problems raised was effected. Accordingly the matter was referred to arbitration. The court sat at Stoke-on-Trent, Lord James of Hereford acting as umpire. On December 30th, 1901, Lord James gave his primary award, and on November 28th, 1903, as was briefly noted two weeks ago, he gave his final award. The umpire has decided that after February 1st, 1904, no glaze shall be used which yields to a dilute solution of hydrochloric acid (0·25 per cent., the same strength as the acid in the gastric juice) more than five per cent. of its dry weight of soluble lead calculated as lead monoxide.

[Lead poisoning is now a trade disease. *Vide* W. C. A., Vol. I.—Ed.].

M. Amand Gautier has presented recently a report on the same subject to the Prefect of Police in Paris, containing large numbers of statistical tables. *Vide* also *Lancet*, 1, 1904, p. 23.

With regard to water, Dr. Taylor wrote in previous editions as follows:—"Water which contains more than one-twentieth of a grain of lead per gallon should be rejected as unsafe. Such a water gives a sensible darkening of colour when a wineglassful of it is placed in a white porcelain dish, acidulated with a few drops of hydrochloric acid, and then a drop of sulphide of ammonium added. Soft waters, more especially those moorland and ferruginous which are acid, and those contaminated with the products of decomposing sewage, are especially prone to act upon metallic lead, and where delivered at house taps often contain half a grain or more of lead per gallon."

The editor has no hesitation in stating that such a limit is far too high, and he agrees with Penny, who says:—"All lead contamination is objectionable, and no degree of it can be considered safe. Lead is an accumulative poison, and affects some persons powerfully in the smallest quantities. It is not so much the quantity of lead taken in any case which determines the symptoms of lead poisoning as its continued introduction."

Toxicity and Fatal Dose.—Lead poisoning occurs in two definite forms, viz., the acute irritative and the chronic, and the cases below would show that the toxicity of lead in the first form is very slight, but there can be no room for doubt that in the chronic form lead is a very dangerous, poisonous substance, not so much, perhaps, dangerous to life as dangerous to health. This arises from the fact that it is a very typical example of what is known as a cumulative poison, *i.e.*, once it has obtained access to the tissues, it is removed from them with exceeding slowness (*vide* Oliver, "Lead Poisoning," 1892).

Nothing certain is known concerning the *fatal dose* of acetate of lead. The facts already detailed show that it may be taken in comparatively large quantities without producing serious effects. Thirty or forty grains have been given daily, in divided doses, without injury. The following additional cases, in some of which recovery took place under disadvantageous circumstances, prove that the acetate of lead is far from being a virulent poison. Iliff met with an instance in which *an ounce* was swallowed in solution; the symptoms were pain in the abdomen resembling colic, with vomiting, muscular rigidity, and numbness. It was three hours before any remedies were used, and five hours before the stomach-pump was employed; but the person recovered. In the second case also, an ounce was swallowed; sulphate of magnesium was freely exhibited, and the stomach-pump was used. On the following morning there was slight excoriation of the gums, which were white, with a sensation of heat in the throat; the bowels were relaxed, probably from the effect of the medicine. The day following there were pains in the legs and thighs, with restlessness and thirst. In a week the woman perfectly recovered. In a case which occurred to Alderson, a man swallowed an ounce of the acetate of lead in a drunken fit. There was violent vomiting, and the man recovered. A case of poisoning by carbonate of lead was reported by Snow in October, 1844, to the Westminster Medical Society. A child, aged five years, ate a portion not so large as a marble, ground up with oil. For three days he merely suffered from pain in the abdomen and costiveness. On the third night the child became rapidly worse, and there was vomiting. He died ninety hours after taking the poison, having passed some offensive motions of a greenish black colour (probably from admixture with sulphide of lead) before he died.

Duration of the acute irritant cases there is little to be said. The symptoms are frequently delayed because the salts have but a feeble actively irritating power, easily influenced by any contents of the stomach, and they rapidly subside on treatment, so far that is as gastro-enteritis is concerned, but in a few hours (occasionally), in a few days (commonly), these symptoms are followed by some of the symptoms of chronic lead poisoning.

In the chronic form it is impossible to estimate the duration either of what may be called the latent period—*i.e.*, the period during which minute doses are entering the body, but have not yet produced symptoms—or of the symptoms themselves when they have occurred. In some cases, under treatment and the avoidance of the poison, recovery may ensue in a few days from colic, or in a few weeks or months from wristdrop, or it may never come on, the paralysis remaining permanently, or death may intervene at any time from the effects on the brain, or from kidney complications.

This marked insidiousness of the symptoms often puts great difficulties in the way of discovering the cause, for though the symptoms and diagnosis may be unmistakable, the habits of the victim may afford no clue, owing to their regularity for long periods.

From a civil point of view it is impossible to put a limit to the possible action of lead, for it can start a condition of kidney trouble, which may persist and progress after lead has ceased to enter the system, and may ultimately cause death. *Vide* remarks on the Workmen's Compensation Act, Vol. I.

Symptoms.—None of the salts of lead are very active poisons as irritants.

Christison states that he has given the acetate in divided doses to the amount of eighteen grains daily for eight or ten days without remarking any unpleasant symptom, except once or twice slight colic. When, however, the quantity taken has been from one to two ounces, the following symptoms have been observed: a burning, pricking sensation in the throat, with dryness and thirst; vomiting and uneasiness at the pit of the stomach, sometimes followed by severe colic. The abdomen is tense, and the walls have been occasionally drawn in. The pain is relieved by pressure, and has intermissions. There is generally constipation of the bowels. If any fæces are passed, they are commonly of a dark colour, indicative of the conversion of a portion of the lead into sulphide. The skin is cold, and there is great prostration of strength. When the case is protracted, the patient has been observed to suffer from cramp in the calves of the legs, pain in the inside of the thighs, numbness, and sometimes paralysis of the extremities. The affection of the nervous system is otherwise indicated by giddiness, torpor, and even coma. A well-marked blue line is noticed after a few days round the margin of the gums, where they join the teeth.

A woman, æt. 21, swallowed about three-quarters of a pint of Goulard's extract of lead (usually containing 24 per cent. of the subacetate), having begun with small doses. When first seen she was in great agony. There was severe colicky pain in the abdomen, which she rubbed frequently, and the muscles of the belly were drawn inwards. The pulse was feeble, there was trembling of the hands, and her body was in constant motion from severe suffering. There was heat in the throat and abdomen, with intense thirst, and a desire to vomit; but there was no actual vomiting or purging. A dose of sulphate of magnesium produced vomiting, and she recovered; but there remained obstinate constipation of the bowels (*Lancet,* 1860, 1, p. 33).

Of what may be called subacute symptoms the persons who ate bread made with poisoned flour (*vide* above) presented rather typical examples. In a few days they complained of a sense of constriction in the throat and the pit of the stomach, violent cramping pains round the navel, rigidity of the abdominal muscles, a dragging pain in the loins, and cramp with paralysis of the lower extremities. There was obstinate constipation, and the urine was scanty and of a deep red colour. Generally the pulse was slow and feeble; the countenance anxious and sunken, frequently of a peculiar livid hue; the tongue flabby; the gums marked by a deep blue line. The surface was cool, and there was a general arrest of the secretions. Sickness was not a uniform symptom, and even when it existed at first it speedily subsided. The mental faculties were undisturbed. Not one of the cases proved fatal, but among the more aggravated there was great prostration, with collapse, livid countenance, universal cramps, numbness, and other alarming symptoms. After apparent convalescence some of the symptoms returned in a more aggravated form without obvious cause, and for a long time the patients were out of health. Purgative medicines were found most effectual in the treatment. The quantity of acetate of lead taken by each person could not be determined, as, on analysis, the samples of bread were found to be unequally impregnated with the substance.

The symptoms of **chronic lead poisoning**, usually divided into four groups, are too fully described in text-books of medicine to warrant detailed notice here, but a few points must be considered.

The recognised groups are—

1. Colic and constipation.
2. Wristdrop.
3. Cerebral affections (lead encephalopathy).

In making a diagnosis of lead as the cause of any of these symptom groups, the lead line on the gums is invariably looked for. In its absence, or in the absence of a clear history of exposure to lead, the cause of the symptoms is often overlooked. Of this lead line it must be noticed (*a*) that it consists in small bluish-coloured dots when examined with a lens; (*b*) that it occurs on the *edge of the gums*, not *on the teeth*; (*c*) that it only occurs on the gums of those teeth which have caries or dirt at the junction of gum and tooth; it is absent with good teeth kept well cleansed; it must be looked for near to stumps or decayed teeth; (*d*) it appears within a week under circumstances of dirt and decay favourable to its production, and (*e*) the shortest time in which it disappears is three weeks. A somewhat similar line may be seen in cases of mercury and copper poisoning [so it is alleged.—Ed.] and in unhealthy mouths utterly innocent of the tooth-brush. The editor has never seen a line that on careful examination as to dotted appearance, colour, and position on the *gum* could possibly be mistaken for lead.

Of the colic nothing need be said except that it requires to be differentiated by clinical rules from other sources of acute abdominal pain (*vide* editor's work on "Differential Diagnosis," Macmillan).

Next to pain there are obstinate constipation, retraction of the abdominal parietes, loss of appetite, thirst, fœtid breath, and general emaciation, with paralysis of a peculiar kind affecting the extensor muscles, and causing a dropping of the wrist, or showing itself in a general paralysis of the limbs. The paralysis is peculiar, and affects at first almost exclusively the extensor muscles at the back of the forearm, so that the patient loses the power of raising the hand from the wrist, hence the name "wristdrop" applied to this form of paralysis. Squinting and amaurosis are occasional symptoms.

The cerebral symptoms are commonly intense headache, accompanied by fits of many varieties closely resembling those of uræmia, and inasmuch as cirrhotic kidney is often associated with (? caused by) chronic lead poisoning, it is certainly possible that these fits may be really uræmic in some cases. Optic neuritis may be present; if acute, it points more directly to lead; if associated with much hæmorrhage and of a chronic type (albuminuric retinitis), it points more to cirrhotic kidney which, however, may have been started by lead.

Works on medicine must be consulted for further details.

Treatment.—In an acute case the stomach must be washed out, and if the patient is not already vomiting, a simple emetic must be given, stimulants to combat shock and depression, if present (though they are rarely seen). A brisk purge should then be administered, preferably of the sulphate and carbonate of magnesia. The sulphate and carbonate of lead are both insoluble salts, and may thus be expelled.

For the chronic cases removal of the source of the poison is the first essential. It has been customary to give iodide of potassium to such cases in the hope of removing the lead from the tissues as a soluble double iodide or albuminate, but Dixon Mann (*B. M. J.*, 1, 1893, p. 401) has shown the futility of the proceeding, and he now relies on magnesium sulphate alone or with other purges. The article contains many other points, and should be consulted.

Morphia and atropine or Tinct. Bellad. (B.P.) are the best drugs for lead colic.

Post-mortem Appearances.—Except for the gums and stomach, there is absolutely nothing characteristic without careful chemical analysis. In one case the mucous membrane of the stomach was much inflamed and of a dark red colour throughout. Lead could not be detected in the contents or tissues of the stomach, nor in the matter vomited. It is remarkable that in this case so small a quantity should have proved fatal without exciting any marked symptoms of irritation in the first instance.

In one acute case of poisoning by the acetate related by Kerchhoffs, the mucous membrane of the stomach was removed in several places, especially near the intestinal opening; and most of the intestines were in a highly inflamed state. In a trial for murder by this substance (*R.* v. *Edwards*, C. C. C., November, 1843), the stomach and intestines are stated to have been found inflamed, and there were dark spots on the former. In animals, according to Mitscherlich, when the dose is large, the mucous coat of the stomach is attacked and corroded; this change appears to be purely chemical, and takes place in all parts of the body with which the salt of lead comes in contact. If given in a small dose, it is decomposed by the gastric secretions, and exerts no corrosive power on the mucous membrane. When acetate of lead was given mixed with albumen and dissolved in acetic acid, death took place with great rapidity; but on inspection the stomach was found uncorroded. This corrosive action is a property of the neutral salt, and is not manifested when the dose is small, or when the poison is mixed with an acid.

Analysis.—*Acetate of Lead as a Solid.*—(1) If a portion of the powder is heated in a small glass tube, it melts, then again becomes solid; again melts, acquiring a dark colour, and gives off vapours of acetic acid and acetone: a black mass is left in the tube, consisting of carbon and reduced metallic lead. No sublimate is formed. If heated alone yellow lead oxide with reduced metal remains. (2) It is very soluble in water, even when cold; spring water is turned milky by it, from the presence of carbonates and sulphates. (3) A small portion of the powder dropped into a saucer containing a solution of iodide of potassium acquires a yellow colour. (4) When dropped into solution of potash it remains white. (5) In sulphuretted hydrogen water or sulphide of ammonium, it is turned black, in which respect it resembles the white salts of some other metals. (6) When the powder is boiled in a tube with diluted sulphuric acid acetic acid, known by its odour and volatility, escapes. All these properties taken together prove that the salt is acetate of lead.

Acetate of Lead in Solution.—If acetate of lead is dissolved in water for the purpose of making further examination, we should note the following points:—(1) A small quantity, slowly evaporated on a glass slide, will give slender white prismatic crystals, which are turned yellow by iodide of potassium, and black by sulphide of ammonium. This solution is said to be neutral; but the common acetate of lead has an acid reaction. (2) *Dilute sulphuric acid* produces an abundant white precipitate, insoluble in nitric acid, but soluble in strong hydrochloric acid, also in a large excess of potash. (3) It is precipitated of a bright yellow colour by *iodide of potassium;* the yellow iodide of lead is soluble in potash, forming a colourless solution. It is also dissolved by concentrated hydrochloric acid. (4) *Sulphide of ammonium*, or sulphuretted hydrogen gas, produces a deep black precipitate, even when less than the 100,000th part of the salt is dissolved. (5) Place a few drops of the solution on clean platinum-foil in a platinum capsule; acidulate with acetic acid; then touch the surface of the platinum through the solution with a slip of zinc. Crystals of metallic lead are instantly deposited on the zinc. By this method a small quantity of the metal may be detected and collected. (6) Zinc alone placed in acid solution slowly displaces the lead. The metal is thus obtained as a dark blue spongy mass.

Lead in Organic Mixtures in the Tissues, etc.—Acetate of lead is precipitated by many organic substances, especially by casein, albumen, and tannic acid. Thus we may have to analyse either an organic liquid containing lead, or a precipitate containing lead. Sulphuretted hydrogen will not separate lead from its compounds with albuminous substances. The fluid, tissue, or organ, such as a part of the liver, should be dried and incinerated in a porcelain vessel. The ash should be heated with a small quantity of nitric acid diluted with four parts of water, and then evaporated nearly to dryness. The residue should be digested in a small quantity of distilled water (free from lead), filtered, and a current of washed sulphuretted hydrogen gas should be passed into it. The production of a brown colour or a brown or black precipitate not readily dissolved by acids indicates the probable presence of lead. The residue insoluble in nitric acid may still contain some lead in the form of sulphate. This may be extracted by boiling with ammoniacal solution of acetate of ammonium. A more accurate method consists in destroying the organic matter by means of chlorate of potassium and hydrochloric acid (p. 354), as volatile compounds of lead may be present. In all cases the brown or black precipitate produced by sulphuretted hydrogen must be redissolved in nitric acid, and other tests confirmatory of lead, such as iodide of potassium and the sulphuric acid test, applied.

White lead is a solid white powder, insoluble in water, and immediately blackened by sulphuretted hydrogen or sulphide of ammonium. (1) When heated on platinum, it leaves a residue of yellow or orange-coloured oxide of lead, soluble in nitric acid. (2) The carbonate is easily dissolved with effervescence by diluted nitric acid. Lead may be readily detected in the filtered solution by the tests already mentioned. Lead is detected in the tissues by incineration, dissolving the ash in dilute nitric acid, and passing sulphuretted hydrogen gas, when a black precipitate of sulphide of lead falls. This may be again dissolved in dilute nitric acid, and other tests applied to the solution.

In snuff it is readily detected by incinerating a small quantity of the snuff in a porcelain capsule, and digesting the ash in warm dilute nitric acid. This may be afterwards diluted with water and filtered before the application of the tests for lead.

When liquids of a comparatively colourless nature, used for drinking or culinary purposes, are impregnated with lead, the fact is immediately known by their being turned of a brown colour by sulphuretted hydrogen. Newly glazed vessels yield traces of lead, more or less, on boiling in them vinegar, pure acetic acid, or a solution of potash. In this manner the poisonous nature of the glaze may be tested, the lead being dissolved either by the acid or the alkali.

Caution in employing the Dry Method for obtaining Lead Residues.—In using the dry process (p. 354), if lead is suspected and organic matter is present, it is as well to remember that the lead compound may be reduced by the carbon to the metal and then alloy with the platinum and possibly fuse a hole in the dish. The carbon should therefore be burnt away with nitric acid as soon as may be, the metals remaining fixed as nitrates or oxides.

Cases.—In 1881, a little girl, aged two years and a half, was noticed to be feverish and restless, and was reported to have had a bad night. The following day she vomited constantly, was unable to take any food, and suffered greatly from thirst. It was considered that she was suffering from severe gastric catarrh, induced probably by sucking cheap coloured crayons, the pink mark of one of which was noticed on the child's mouth. In a few days the child rallied, and it was thought that all danger was over; but on the twenty-third day of the illness she was seized with convulsions, and the next day she died. All the organs were healthy, with the exception of the brain and stomach. The left side of the brain is reported to have been distended with fluid, whilst the stomach presented signs of acute inflammation, and in two places perforation had occurred. Either the effusion into the ventricles or the condition of the stomach might, it was considered, have accounted for the fatal issue. An analysis of the crayons showed that they all contained poison. The most poisonous was a pink one, which contained more than half its weight of white lead, coloured with an innocuous vegetable substance. The weight of this crayon was fifty grains. Another crayon contained Prussian blue, mixed with Dutch pink (*B. M. J.*, 1882, 1, p. 669).

The following case, taken from the *Chemist and Druggist*, July 2nd, 1898, shows the evil effects of lead as an agent for abortion:—

At an inquest held at Leicester on June 22nd respecting the death of a child from marasmus arising from lead poisoning, it was disclosed in evidence that the mother of the child, while pregnant, had taken some pills made by a Mrs. Hands, which had made her so ill that she had discontinued them. Mrs. Hands was called in, and stated that she was the wife of a shoe operative. She circulated printed bills advertising certain pills for use by ladies. She had no medical qualification, and did not need one. The pills were made from a "thoroughly well-thought-out formula" given to her by a chemist named Harrison, who now lived at Derby. The reason she knew it was a "well-thought-out-formula" was because it had been sent to London to the Medical Hall to be examined. She had not the formula with her, but she knew that amongst the ingredients were iron and belladonna. She had made up the pills herself when she had not been busy, but she usually had them prepared by chemists in the town, and any doctor was at liberty to inspect the formula from which the pills were made. A verdict of death from marasmus, the result of pre-natal lead poisoning, was returned, the coroner observing that certain suspicious facts had come out which might possibly be the subject for inquiry by the police.

For cases of lead poisoning due to the taking of diachylon to procure abortion *vide* under "Abortion," p. 167; also for two such ending fatally, *B. M. J.*, 1, 1893, p. 9. In the *B. M. J.*, 1, 1904, p. 433, Dr. Leslie Roberts reports the case of a compositor who exhibited symptoms of chronic metallic poisoning from handling type made of antimony and lead.

POISONING BY ARSENIC.

Source and Method of Occurrence.—More interest attaches to arsenical poisoning, perhaps, than to any other form of this kind of violent death, owing to the fact that it is the form most commonly chosen by murderers.

Arsenic in some form or other is very largely indeed used in arts and manufactures, and is consequently prepared in enormous quantities. The following is a list of arsenical compounds which have been known to give rise to symptoms of poisoning, but there is no substance, which on analysis shows the presence of arsenic, which may not cause them:—

1. (Probably the most common form), arsenious acid, also known as white arsenic, or, more commonly but erroneously, simply arsenic.
2. Arsenites of potash and soda.
3. Copper compounds or arsenical pigments.
4. Arsenic acid and arseniates.
5. Sulphides of arsenic.
6. Chlorides of arsenic.
7. Arseniuretted hydrogen.
8. Caccodylates of arsenic.

1. **White Arsenic, Arsenious Acid.**—The term *white arsenic* is commonly applied to the arsenious oxide or acid of chemists. It is seen under the form of a white powder, visibly crystalline in a strong light, or when viewed with a lens. It is also met with in opaque, brittle white masses, resembling enamel. It is called an acid from its power of combining with alkalies, but it possesses only a feeble acid reaction when dissolved in water. It is often described as having an acrid taste, but this does not appear to be correct; a small quantity of it has certainly no appreciable taste, a fact which may be established by direct experiment. It would appear, from numerous cases on record, that it has been unconsciously taken in fatal quantities, in all descriptions of food, without exciting any perceptible sensation on the tongue. Most of those persons who have been criminally or accidentally destroyed by arsenic have not been aware of any taste in

taking the poisoned substance. In cases in which the powder has been taken in *large* quantity, it is described as having had a *roughish* taste. Water boiled for an hour on the poison and allowed to cool holds dissolved the fortieth part of its weight, or about twelve grains in one ounce. If boiled for a shorter time not more than the eightieth part will be dissolved. Cold water allowed to stand for many hours on the poison does not dissolve more than from the thousandth to the five hundredth part of its weight, *i.e.* one half-grain of arsenic to nearly one fluid ounce of water. These results vary somewhat according to the length of time the arsenic has been kept. It appears to alter its molecular constitution and its solubility by age. When arsenic in powder is mixed with cold liquids, a portion of the powder floats and adheres to the sides of the vessel, a very characteristic phenomenon which should not be forgotten in testing a powder for arsenic.

Arsenic, as it is sold to the public in small quantities, is required to be mixed either with the sixteenth part of its weight of soot, which gives to it a greyish colour, or the thirty-second part of its weight of indigo, and then it is blue. Both of these colours are rendered much deeper when the powder is wetted, so that the sooty compound is then nearly black. Sometimes, in place of indigo, artificial ultramarine is employed as a colouring. The Act regarding the colouring of arsenic (14 Vict. c. 13, s. 3) is frequently evaded. It is sometimes sold uncoloured under the name of *mercury*.

Mixtures of white arsenic, soft soap, and either sulphur or tar-water, are largely used in agricultural districts for killing the fly in sheep. These have caused death, under the usual symptoms of arsenical poisoning, in several instances.

In 1874, the Coombs family, consisting of eight persons—the father, mother, and six children—were all poisoned by drinking water from a bucket which had contained an arsenical sheep-dipping composition. The mother and three of the children died. The symptoms produced were unusual, diarrhœa being a less prominent symptom than vomiting. The poison appeared to exercise a profound impression upon the nervous system, producing tetanic spasms and convulsions. An arsenical rash was a characteristic of the severest and fatal cases. In the bodies of the mother and one child Sir T. Stevenson detected arsenic. The bodies of the other two children were not examined for poison.

2. **Arsenites of Potash and Soda, Liquor Arsenicalis (Fowler's Solution).**—There is, perhaps, only one case recorded in which Fowler's solution has destroyed life. A woman took half an ounce (=two grains of white arsenic) in divided doses during a period of five days, and died from the effects. There was no vomiting or purging, but after death the stomach and intestines were found inflamed (*Prov. Jour.*, June 28th, 1848, p. 347).

Arsenite of Sodium is as poisonous as arsenite of potassium.

In December, 1857, 340 children belonging to an industrial school near London were poisoned by this compound. It had been incautiously used for cleansing a steam boiler, and had thus become mixed with the hot water which was drawn for the breakfasts of the children. The dose of arsenic taken by each child was about one grain. All recovered, although some suffered severely. In the winter of 1863, a man died under symptoms of acute poisoning by arsenic owing to his having drunk beer out of a pot which had contained this *patent* cleansing liquid.

"Weed-killers" are solutions of arsenite of sodium.

In 1891, a man named Wesley died, and four members of his family were made seriously ill, by drinking gooseberry wine stored in a cask in which a weed-killer had been sent out. Each fluid ounce of the wine was found by Sir T. Stevenson to contain nearly six grains of arsenious acid. It was noted that no one, except the man who died, had any cramp in the calves of the legs. Several other deaths occurred about the same time from these weed-killers; and in 1891 an extensive series of cases of poisoning by sugar into which a weed-killer had leaked during transit was recorded by Thom (*Lancet*, 1891, 1, p. 900).

Fly-water is a name applied to solutions of various arsenical compounds in water. Mixtures of this kind are formed by dissolving one part of the arsenite of sodium or potassium and two parts of sugar in twenty parts of water. Paper soaked in this solution, and dried, is used for poisoning flies; and perhaps this is the safest form in which arsenic can be used for such a purpose.

A case of poisoning by fly-water, in which two grains and a half of arsenious acid destroyed the life of an adult in thirty-six hours, is reported (*Med. Gaz.*, vol. 39, p. 116). In 1884, two women were convicted of the murder of the husband of the younger of them by means of arsenic. They had procured fly-papers, soaked them in water, and administered the liquid to the deceased. It is known that several persons were in this way murdered by these women (*R.* v. *Flannigan and Higgins*, Liverpool Wint. Ass., 1884).

According to Sir T. Stevenson's analysis, an ordinary fly-paper of about the area of a page of this book contains five grains of arsenic. Fly-powder is a dark-coloured mixture of metallic arsenic and arsenious acid.

Death has taken place from the external application of this form of arsenic, though rarely.

In 1864, a girl, æt. 9, died rather suddenly after an illness of about ten days. The mother had rubbed some white precipitate ointment, mixed with arsenic, on the head of the child, which was diseased. Her object, she stated, was to kill the vermin on the scalp. No symptoms of note were observed until about the fifth day after the application, when the child appeared ill and complained of thirst. On the eighth day she was very unwell; there had been cramp, with slight action of the bowels, but no vomiting. She became drowsy, and died on the tenth day. The lining membrane of the stomach and duodenum was inflamed: in the stomach the inflammation was well marked towards the greater end; these were the principal post-mortem appearances. Traces of arsenic were found in the mucous fluids of the stomach, in the coats of the stomach, in the intestines, and in four ounces of the liver; but arsenic in a solid form could nowhere be detected. A portion of the diseased hairy scalp was examined, and yielded arsenic as well as mercury (from white precipitate) in large proportion, the arsenic being estimated at from two to three grains. From the evidence given at the inquest there was no doubt that the mother's account was correct, and that her child had died from the ignorant application of arsenic externally to a diseased portion of the scalp.

In 1878, some remarkable cases of poisoning by the external use of violet-powder mixed with white arsenic occurred at Loughton, in Essex, and in other places. Though a number of children died suddenly with somewhat similar symptoms, in two cases only were post-mortem examinations and analyses of the viscera conducted. One child, a female, was at birth described by the nurse as a healthy child. It was washed, as usual, shortly after birth, and was then dusted all over with the violet-powder, a sample of which was subsequently ascertained to contain 38½ per cent. of white arsenic. Later on in the day the powder was again applied to the private parts of the body. On the second day the powder was applied four times. On this day there was very marked redness and inflammation of the skin, and this led the nurse to apply the powder unusually freely, especially over the stomach, where the redness was most noticeable. On the third day the skin was intensely red, and appeared in parts—especially about the navel, the vagina, and the anus—of a yellow and unhealthy hue. In consequence of it being suspected that the violet-powder contained some irritant substance, its use was discontinued, and common starch-powder was used instead. On the succeeding day the eruption became very much worse, and in some parts the skin commenced sloughing. On the tenth day of the child's life, and on the sixth day from the last application of the violet-powder, the child died from exhaustion. A post-mortem examination, made five days after death, revealed nothing marked in the condition of the viscera. From the exhumed body six and a half grains of arsenic were obtained by Tidy.

There is no doubt that the white arsenic had been accidentally mixed with the violet-powder in mistake for terra alba (sulphate of lime or hydrated calcium sulphate), which is a constituent of some kinds of violet-powder. This is not the only instance of such a mistake having occurred. At Bradford, in 1858, seventy persons suffered, and seventeen died, from the effects of eating peppermint lozenges, adulterated with white arsenic, in mistake for "daft" (sulphate of lime), which was at one time commonly used for the adulteration of cheap lozenges.

A confectioner, intending to adulterate lozenges with plaster of Paris, mixed with them a quantity of white arsenic which had been supplied to him through mistake for the plaster. More than 200 persons partook of these poisoned lozenges, and suffered the usual effects. Seventeen persons died, twelve from acute poisoning and five from the secondary effects. A trial took place, but the law could not fix the responsibility for the act upon any person.

It is not often that a case is heard of in which white arsenic has caused death by reason of its having been breathed or swallowed in the state of vapour.

In 1858, a case involving the effects of arsenical vapours was the subject of an inquest in London (see "On Poisons," 2nd ed., p. 234); but on that occasion there was an entire failure of proof that the arsenical vapour was the cause of death. In a case which was the subject of a trial at the York Lent Assizes, 1864, the prisoner placed some burning pyrites, containing arsenic, at the entrance of the door of a small room in which there were eight children, including an infant in a cradle. From the evidence it appeared that all the children suffered from the fumes, which were chiefly those of sulphurous acid. A canary that was in a cage died from the effects. The children were speedily removed from the house, and recovered, but the infant was left there for an hour. It suffered from vomiting, and when seen about seventeen hours afterwards, the child was pulseless; it vomited incessantly, was much purged, and appeared to be in great pain. It died about twenty-four hours after exposure to the fumes. On inspection the stomach and intestines were found slightly inflamed. The brain and lungs were congested, and the lining membrane of the trachea was of a bright red colour. Allen detected arsenic in the contents of the stomach, in the lungs, in the coats of the stomach, and in the spleen. None was found in the liver. The pyrites contained arsenic, and gave off while burning arsenious acid in vapour and sulphurous acid. Some of the appearances were due to sulphurous acid; but death was probably caused by arsenic. The prisoner was found guilty of manslaughter. A case is reported in which it is stated that the members of a family were made ill by arsenical vapours escaping from the walls of a room, and that one of them died (*Pharm. Jour.*, July, 1870, p. 66).

3. **Copper Arsenite, Scheele's Green, Emerald Green, etc.**—This is the only metallic arsenite which is met with in commerce and the arts, and it constitutes, wholly or in part, a great variety of green pigments, known as emerald green (aceto-arsenite of copper), employed for paper-hangings, mineral green, Brunswick, Schweinfurt,

or Vienna green. It is thus found in the form of oil-paint, in cakes of water-colours, wafers, adhesive envelopes, or, rarely, spread over confectionery, and lastly, and most abundantly, in various kinds of green decorative papers used for covering the walls of rooms.

In a case which was the subject of a criminal trial, this substance was proved to have caused the death of a gentleman by reason of its having been employed to give a rich green colour to some blanc-mange served at a public dinner, the person who employed it considering that emerald or mineral green was nothing more than an extract of spinach, a substance from which the green pigment used in confectionery is made. It led to death under the usual symptoms, and the parties were convicted of manslaughter and sentenced to imprisonment (*R.* v. *Franklin and Randall*, Northampton Sum. Ass., 1848).

Among other uses of this obnoxious compound, it has been employed for imparting a bright green colour to the shelves of bakers' and greengrocers' shops. An incident which occurred to the author will show that food may thus acquire an arsenical impregnation. Several loaves of bread were supplied to him having upon the under-crust some green-coloured pigment, which on analysis turned out to be arsenite of copper, containing about 50 per cent. of arsenic. On inquiry he found that the baker had recently painted the shelves of his shop with this pigment, and the hot loaves placed upon them had taken off a portion of the arsenical paint (*Med. Times and Gaz.*, April, 1854, p. 326).

Another form of poisoning by this substance which has attracted some attention is where the green pigment exists in the state of vapour or fine dust, and comes in contact with the membrane of the lungs or with the skin.

A young man, after having been engaged for nine days in painting with an arsenical green pigment, was seized with irritation and watery discharge from the nose, swelling of the lips and nostrils, and headache. The next day he experienced severe colic and great muscular weakness, but these symptoms disappeared in about eight days. It is probable that in this case arsenite of copper had been taken into the body through the mucous membrane of the lungs in the state of fine powder.

According to Bouchardat ("Ann. de Thérap.," 1846, p. 209), the workmen who handle the emerald green in making wall-papers are subject to serious disorders of health. They sometimes suffer from eruptions of the skin, one of the local effects of poisoning by arsenic (see *Assoc. Med. Jour.*, 1856, September 6th, p. 757, and September 20th, p. 810), with œdema (watery swelling) of the face, and boils frequently forming in the scrotum.

Wall-papers covered with the loosely adhering aceto-arsenite of copper were formerly, from their cheapness as well as their brightness of colour, extensively used in dwellings. This pigment contains 59 per cent. of arsenic, and from some of these papers in the unglazed state the noxious material may be easily scraped or removed by friction. A square foot may yield from twenty-eight to seventy grains of the arsenical compound, and in rooms exposing five or six hundred square feet arsenic is thus liable to be distributed in the state of a fine dust or powder through the air of a room. This poisonous dust has been detected on books, picture-frames, furniture, and projecting cornices in rooms thus papered. Workmen who hang these papers or who strip them off the walls suffer from symptoms referable only to the action of arsenic (see Husemann, "Jahresber. der Toxicol.," 1871, p. 525, and *Pharm. Jour.*, 1870, p. 218; also *Lancet*, 1870, 2, p. 356). One of the author's friends, who had his library papered with an arsenical wall-paper, suffered severely from symptoms of arsenical poisoning, which came on after he had been occupied in dusting his books. The dust contained a well-marked quantity of arsenic. In two cases which proved fatal in 1865, the workmen suffered chiefly from vomiting and colicky pains. The skin was tinged of a green colour, and arsenic was detected in the soft organs. He found that all poisons were liable to be absorbed by the unbroken skin when, as a result of evaporation, a solid film was left on the surface. Kirchgässer has collected twenty-one cases of poisoning as the result of persons inhabiting rooms the walls of which were covered with this green arsenical pigment. Some of these proved fatal. The poison appears to have entered the body in the form of a fine powder or dust. Arsenic was in many cases detected in the urine of the patients (Horn's *Vierteljahrsschr.*, 1868, 2, 96; also "Ann. d'Hyg.," 1869, 1, 480). Delpech has published some facts which show that similar symptoms of poisoning have arisen from a person occupying a room filled with stuffed birds and animals in the preservation of which an arsenical compound had been used. Arsenic was found in the dust of the room and on the furniture ("Ann. d'Hyg.," 1870, 1, 314).

Various deaths from the use of these arsenical papers are recorded, and it is probable that to the practice of covering the walls of sitting and bedrooms with arsenic many insidious cases of illness and chronic disease may be referred. The arsenical compound has also been much used for colouring artificial flowers, wreaths, and tarlatan dresses. Dressmakers occasionally suffer seriously from this form of poisoning.

Two women were employed to make some green tarlatan into ball-dresses. They noticed an unpleasant smell and taste, and their eyes were affected during the performance of the work. The symptoms from which they suffered were swelling of the eyelids, congestion of the conjunctivæ, and copious secretion of tears. The one most affected experienced on the second day salivation, with an unpleasant taste in the mouth, cramps in the limbs, great thirst, restlessness, and difficulty of breathing. These symptoms lasted in one patient eight, and in the other fourteen days.

Riedel, who describes these cases, suffered severely from a similar train of symptoms for several days, as a result of handling the poisoned dresses for the purpose of analysis. He found that the stuff contained 13 per cent. of its weight of arsenic (Husemann, "Jahresber. der Toxicol.," 1871, p. 525; 1872, p. 480). To this list may be added the case of a lady (July, 1872) who suffered severely from symptoms of arsenical poisoning by reason of her having worn, on one occasion only, a dress of this description. Paper used for adhesive envelopes, for wrapping confectionery, children's food, isinglass, chocolate, etc., is also occasionally coloured with arsenical pigments.

[These pigments are not now used for these purposes so extensively as they were.—Ed.]

4. **Arsenic Acid and Arseniates of Sodium and Potassium.**—Arsenic acid was formerly employed in the manufacture of magenta, rosaniline, and other colours from aniline. There is reason to believe that the colour is sometimes sent into the market contaminated with arsenic. Rieckher found from 1 to 7 per cent. of arsenic acid in the red colours supplied by good manufacturers, and frequently arsenious acid was also present (*Med. Times and Gaz.*, 1870, 1, 617). As these red compounds are used for giving a beautiful red colour to liqueurs, syrups, raspberry vinegar, and sugar sweetmeats, there is a possibility that accidents may occur from their use. They are rich in tint and of great cheapness (*Med. Times and Gaz.*, 1870, 1, pp. 46, 84). The injurious effect of several of these coal-tar pigments when used for dyeing socks and gloves has been ascribed to the arsenic contaminating the dyes, but perhaps in most instances incorrectly. But few cases of fatal poisoning by the *arseniates* are recorded.

5. **Sulphides of Arsenic: Orpiment and Realgar.**—Orpiment, or yellow arsenic, owes its poisonous properties to the presence of a variable proportion of arsenious acid. Sir T. Stevenson met with a fatal case in 1865. Orpiment is much employed in the arts, in painting, dyeing, paper staining, and even in the colouring of toys, but is not often used as a poison. In December, 1859, six persons suffered from the usual symptoms of poisoning by arsenic owing to their having eaten *Bath buns*. It was found that a confectioner at Clifton had used, as he supposed, chrome yellow (chromate of lead) to give the buns a rich yellow colour, and make them saleable; but the chemist to whom he applied had ignorantly supplied him with orpiment. This wholesale system of poisoning is one of the attendant evils of adulterating articles of food. Orpiment mixed with lime is extensively used in the processes of fellmongering and tanning for the purpose of removing the wool of the sheep from the hide. Sir T. Stevenson has seen severe injuries result from the mixture coming accidentally into contact with the skin of those engaged in the trade. In one case, two persons partook of some porridge in which orpiment had been put by mistake for turmeric. One, an old man, died in twenty-two hours; the other, a boy, recovered. On inspection there was violent inflammation of the gullet and stomach, the mucous coat of the latter being softened and thickened. There was a gangrenous spot, one inch in diameter, in the gullet, and another in the stomach, three inches in extent (Wharton and Stille, "Med. Jur.," p. 434). According to Chevers ("Med. Jur. for India," p. 74), orpiment is much used in India, both as a medicine and as a poison. He refers to eight instances in which this poison was found, either in food or in the stomachs of persons who had died under symptoms of irritant poisoning. Orpiment and realgar (another sulphide of arsenic) are sold openly in India, and are used as depilatories. Orpiment has been known to cause death by *external* application as a depilatory (see "Ann. d'Hyg.," 1834, 459).

In *R.* v. *Sturt* (Lewes Lent Ass., 1863) a novel question arose respecting this compound. There was some reason to believe that the deceased woman had died from the effects of arsenic administered in confectionery. White arsenic was found in the stomach, and a question was put by the judge, as well as by the counsel for the prisoner, whether the confectioner might not have used yellow arsenic by mistake in order to give a colour, and this yellow arsenic have been converted in the deceased's body in twenty-four hours into white. It need hardly be remarked that the yellow colour is an essential character of orpiment. White may be converted into yellow arsenic in the dead body, but yellow cannot be spontaneously changed into white arsenic.

6. **Chloride of Arsenic.**—This is an official solution of arsenic in diluted hydrochloric acid. It contains 1 per cent. of arsenious acid. It is a highly poisonous preparation, and by a case in Guy's Hospital in May, 1857, this statement is confirmed. A woman took three doses in a period of twenty-four hours. The quantity of arsenic thus taken was not more than the *tenth part* of a *grain*, and yet the symptoms which followed were of a severe kind, resembling those of chronic poisoning. The medicine (a poison) was withdrawn, and the patient slowly recovered. It seems that she had not taken arsenic previously; and there was an obvious peculiar susceptibility to the effects of arsenic. The quantity taken was very small to produce such alarming effects. The official dose is from three to ten minims.

7. **Arseniuretted or Arsenetted Hydrogen.**—This is a gaseous poison of arsenic, producing, when respired in small quantity, very serious effects upon the system. It has already occasioned death in several instances (see "On Poisons"; *Chem. News*, December 26th, 1863, p. 307; "Jahresber. der Toxicol.," 1871, p. 522).

In 1892, two deaths occurred at Llanelly from the inhalation of an impure form of this gas. Two men dissolved in hydrochloric acid, in an open tube, a mixture of metals containing 0·8 per cent. of arsenic and some antimony. The gases liberated would contain both arseniuretted and antimoniuretted hydrogen gases. One of the three men engaged in the operation was exposed to the fumes for ten or fifteen minutes. About six hours after he was seized with diarrhœa and severe abdominal pains; on the following day he was jaundiced; on the sixth day he seemed better; and on the seventh day paralysis of the arms and legs supervened, and he died suddenly. One of the assistants suffered from similar symptoms, and died on the tenth day (*Public Health*, vol. 4, 1892, p. 317).

It would seem probable from the following experiments that it is by means of this gas that some of the fabric and wall-paper cases may occur. Thus two theories hold the field: (1) that of Forster, who believes that the poisoning is due to detachment of solid particles from the stuffs which float in the air and enter the body by means of the respiratory passages; and (2) that proposed by Selmi, who considers that toxic gases may be formed from the pigments by the action of microbes. Some experiments undertaken by Gosio ("Laboratory Reports of the Public Health Department," Rome, September, 1891) lend a good deal of support to this latter view. This observer made nutrient media of potato paste, impregnating them in some cases with arsenious acid, and in others with various arsenical pigments; the nutrient media thus prepared were exposed for some days to a constant current of air, which was drawn over them by means of an aspirator. The air, after it had passed over the paste, was made to bubble through a solution of nitrate of silver, which would detain all volatile arsenical compounds which might have been formed. As a result of this first rough experiment the author found that many moulds and some fission fungi developed on the arsenical media, and that very appreciable quantities of volatile arsenic compounds were given off. Proceeding then to isolate the different species which developed, and testing the action of each on fresh sterile prepared media, he found that only two species—*Mucor mucedo* and in a less degree *Penicillium glaucum*—were able to split up the solid arsenical compounds as above described. From a great number of experiments he came to the following conclusions:—(1) *Mucor mucedo* will grow well in presence of a notable quantity of arsenic; it seems to grow more luxuriantly under these than under normal conditions. (2) Many fixed compounds of arsenic, and among them the green pigments ordinarily used, are changed by the growth of these moulds into gaseous bodies, among which is certainly arseniuretted hydrogen. (3) The sulphides are not decomposed like the oxygenated compounds, but their presence in the culture media seems in no way detrimental to the growth of the moulds. (4) Under certain conditions of light, moisture, and temperature, it is possible to obtain arsenical gas by the growth of *Mucor mucedo* (and perhaps other mucorinæ) on tapestry coloured by either Scheele's or Schweinfurt's green. Thus, without denying the possibility of occasional poisoning by detached particles, Gosio considers he has made out a strong case in favour of the gaseous theory of arsenical poisoning.

These fungi may be utilised for toxicological purposes in the detection of arsenic (*Lancet*, 2, 1903, p. 1728).

8. The **caccodylates** of arsenic and other organic compounds of the metal under fancy names, atoxyl, etc., have recently been introduced into medical practice, owing to their alleged low degree of toxicity. There is no doubt but that they are less poisonous than most arsenical compounds, but the degree of safety is very limited, and many cases can be found in the medical journals of the last few years inculcating caution in their administration. *Vide* cases at the end of this subject; also *Lancet*, 1909, 1, p. 1769, and reports of Ophthalmological Society in 1909 and 1910.

Arsenic in Beer.—Towards the end of November, 1900, Dr. Reynolds, of Manchester, by keen clinical observation, was led to suspect the presence of arsenic in beer. His suspicions were verified, and led to some very startling revelations in regard to the presence of arsenic in various foods. In his particular cases, however, the arsenic was traced to glucose used in brewing, and then in turn to sulphuric acid used for making glucose. The matter was so important from a national health point of view that a powerful Royal Commission sat upon it. The report of this Commission was issued late in 1903 (Eyre & Spottiswoode, 5½*d*.). In the *Lancet*, 2, 1903, pp. 1674 and 1746, will be found an instructive summary of this report, and from that summary the following notes are made:—

"The final report is divided into the following parts":—

1. Further observations regarding the epidemic of arsenical poisoning in 1900 and as to the medical and public health aspects of the evidence received regarding arsenic in beer and food.

2. The suggested relation between the disease "beri-beri" and arsenical poisoning.

3. Tests for arsenic in foods and substances used in the preparation or manufacture of food.

4. Ways in which foods are liable to become contaminated by arsenic.

5. Precautions which should be taken by manufacturers to exclude arsenic from foods.

6. Present means of official control over purity of food in relation to arsenic.

7. Recommendations as to improvements in official control over the purity of food.

8. Recommendations as to the proportions of arsenic in food which should now be held to constitute an offence under the Sale of Food and Drugs Act.

The Commission was satisfied that certainly 6,000, and probably more, people were affected.

The symptoms are fully discussed, and the Commission reports on them thus:—

"There were great differences in individual cases as regards the quantity of arsenic in the beer consumed, the amount of beer taken, and the duration of the period over which arsenical beer was drunk; and there were also further differences between individual beer-drinkers —*e.g.*, as to age, sex, health, conditions of nutrition, and habits as regards alcohol—which determined the extent of their susceptibility to arsenical poisoning at the time when they began to take beer containing arsenic. . . . Corresponding to these and other differences, the disease produced by the arsenical beer during the epidemic varied greatly in its manifestations. On the one hand, there occurred throughout the epidemic (and particularly, it would seem, towards its termination, when people had been drinking arsenical beer for many weeks or months, and so had taken considerable quantities of the poison) an abundance of cases in which, once the possibility of arsenic was entertained, there was comparatively little difficulty in deciding on clinical grounds that the illness was consistent with arsenical poisoning. Such cases presented symptoms corresponding to those described as characteristic of subacute poisoning by arsenic, or which are met with in the poisoning which occasionally results from long-continued doses of arsenic taken medicinally. They showed, for example, inflammation of various mucous surfaces, leading to coryza, huskiness, lachrymation, and the like; gastro-intestinal disturbance and diarrhœa; peripheral neuritis affecting sensory and motor nerves, and in some cases associated with herpes or with well-marked erythromelalgia keratosis, or recent pigmentation corresponding to that which not infrequently occurs in persons taking arsenic for long periods.

"On the other hand, symptoms of the above kind were often slight or absent altogether, and one of the most instructive points in connection with the outbreak is the occurrence of cases in which the symptoms, if taken by themselves and apart from the epidemic, would not have appeared to be readily or sufficiently explained by the suggestion that arsenic was the cause of illness. Thus in several comparatively mild cases the sufferers complained merely of burning hands and feet, or they showed a variety of skin eruptions which are observed in many conditions which have nothing to do with arsenical poisoning. In other cases, again, the main symptoms were those resulting from dilated heart; and special difficulty arose in cases showing evidence of well-marked peripheral neuritis not associated with symptoms pointing clearly to arsenic, and which appeared practically identical with 'alcoholic neuritis,' a disease previously considered to be the result, alike in drinkers of beer and spirits, of the toxic action of alcohol on nerve tissue."

On the tests for arsenic the *Lancet* thus comments on the report :—

" The Commission has received a great deal of chemical evidence, especially from two strong committees, one a joint committee of the Societies of Public Analysts and Chemical Industry, with Mr. Otto Hehner as chairman, and the other, with Dr. Thorpe as chairman, appointed by the Board of Inland Revenue to advise as to arsenic in beer ingredients. The report deals with the essential principles of applying what is now termed the 'Marsh-Berzelius test' to various substances. In this test, as is well known, the arsenic from the arseniuretted hydrogen is deposited, not on a porcelain tile, as in the 'Marsh' test, but in a capillary tube. Within a certain range 'mirrors' of arsenic deposited in these tubes show definite differences in intensity according to the quantity of arsenic present, and an estimation is made by comparing the intensity of the mirror obtained from a given weight of substance with a set of standard mirrors. Attention to various points of detail is essential to accuracy. In nearly all cases it is necessary in the first instance to destroy completely any organic matter present. The presence of iron salts in the Marsh apparatus may seriously vitiate the result. It is not only necessary to have zinc which is free from arsenic, but also zinc which is 'sensitive' and does not retain the arsenic in the solution tested. The Commission finds that chemists are now agreed as to these and other sources of error which it is necessary to avoid, and that if due regard is had to these points differences as small as 0 2 part of arsenic per million in the substance taken or 0·0014 grain of arsenic per pound can be readily distinguished. . . . The presence of arsenic will be detected when in amounts well below $\frac{1}{1000}$th of a grain per pound or $\frac{1}{3000}$th of a grain per gallon. The Departmental Committee has found that in the case of beer ingredients many of the difficulties attending the Marsh-Berzelius test are obviated by an electrolytic method of evolving arseniuretted hydrogen, which can be applied wherever a current of sufficient intensity is available."

The Commission then deals exhaustively with various articles of diet in which arsenic has been found : glycerine, caramel, baking powders, malt, treacle, jams with glucose, vinegar, Demerara sugar, malted foods, etc.

As this report will doubtless for many years to come be the official standard to which every question on arsenical poisoning will, in England at least, be referred, it is absolutely essential that it should be in the hands of every analytical chemist who may be concerned in a case. As we have already stated, it may be obtained from Eyre & Spottiswoode, Parliamentary Printers, London, England, price 5½*d*., and is therefore within every one's reach.

Toxicity and Fatal Dose.—The various compounds just discussed would certainly seem not to have the same degree of toxicity, but they seem to agree in this, that their effects are always due to arsenic, nor do they differ as widely in fatal dosage as the per- and sub- salts of mercury, though the organic ones are certainly two or three times less poisonous than the others.

The smallest fatal dose hitherto recorded was observed in a case communicated by Castle (*Prov. Jour.*, June 28th, 1848, p. 347). A woman took half an ounce of Fowler's solution (arsenite of potassium). in unknown doses, during a period of five days. She then died, and on examination the stomach and intestines were found inflamed. Death took place by syncope, and there was an absence of vomiting and purging. The quantity of arsenic which here destroyed life could not have been more than *two grains.* In another case, two grains and a half of arsenic, contained in two ounces of fly-water, killed a robust healthy girl, aged nineteen, in thirty-six hours (*Med. Gaz.*, vol. 39, p. 116). Hence, under circumstances favourable to the operation of the poison, the fatal dose in an adult may be assigned at from **two to three grains.**

Orfila states that arsenic acid is a more powerful poison than arsenious acid, but he does not adduce any instance in support of this opinion. Maumé, on the contrary, states that it is less poisonous than arsenious acid.

Although arsenite of copper is insoluble in water, it is sufficiently soluble in the acid fluids of the stomach to be taken up by the absorbents, and carried as a poison into the blood, and apparently two or three grains must be accepted as a fatal dose.

A boy, aged three years, swallowed a small capsule of Scheele's green used as a pigment. In half an hour he complained of violent colic: there was frequent vomiting, with purging, cold sweats, intense thirst and retraction of the parietes of the abdomen. The mouth and throat were stained of a deep-green colour. Hydrated ferric oxide was given: in about an hour the vomiting ceased, and soon afterwards the thirst and pain in the abdomen abated. The next morning the child was well. In another case a child, a year old, ate several pieces of a cake of arsenite of copper used for colours. There was immediate vomiting of a liquid containing green-coloured particles of the arsenite, but there were no other urgent symptoms. White of egg, with sugared water, was given. After a short time the child became pale and complained of pain in the abdomen: the pulse was frequent, the skin cold, and there was great depression. Copious purging followed, soon after which the child recovered ("Galtier," vol. 1, p. 636). In the cases of two children poisoned by confectionery coloured with this substance, the chief symptom was incessant vomiting of a light green-coloured liquid, resembling bile diluted with water (*Med. Times*, April 28th, 1849, p. 507). The symptoms were described as severe, although the quantity of poison swallowed was small. Under the use of an emetic of ipecacuanha, the children recovered (see also Guy's Hosp. Rep., October, 1850, p. 218; *Med. Gaz.*, vol. 43, p. 304; *Edin. Month. Jour.*, July, 1851, p. 1; and *Lancet*, 1859, 1, p. 237). In two cases in 1853, a small quantity of a confectionery ornament, coloured with arsenite of copper, proved fatal to two children. The symptoms and appearances were those of poisoning by arsenious acid. The quantity taken could not have been above two or three grains. The children picked up the ornament in the street and shared it between them. The poison was spread over a layer of sugar.

Orpiment produces symptoms and appearances similar to those caused by arsenious acid; but the dose required to destroy life varies according to the proportion of arsenious acid with which it happens to be mixed, the acid being more toxic than the orpiment.

Duration.—Arsenic being an irritant to the stomach, even in essentially small quantities, the symptoms usually come on within a quarter to half an hour after the dose. Christison mentions one instance in which the symptoms began in eight minutes; but in the case of Lofthouse (York Lent Ass., 1835), the symptoms were proved to have attacked the deceased while he was in the act of eating the cake in which the poison was administered. On the other hand, in an instance where one drachm had been taken on an empty stomach, no symptoms appeared for two hours. In a case reported by Orfila, the symptoms did not show themselves for five hours; and in another, in which a large dose was taken, the symptoms did not come on for seven hours. There may be every variety between these extremes. In one case their appearance was protracted for *ten* hours, the maximum period yet known. A remarkable instance occurred in which the poison was taken by a young female at eleven o'clock in the morning, and no well-marked symptoms occurred for *eight hours*: there was then violent vomiting. After death, a cyst, formed of mucous membrane containing arsenic, was found in the stomach: the poison having thus become sheathed over (Flandin, vol. 1, p. 535). In another case (*Med. Times*, October 21st, 1848), symptoms of violent irritation did not show themselves until twenty-three hours after the poison had been taken, and within about half an hour of the death of the patient. The girl was sick once shortly after having taken the poison, but the first symptoms were those of narcotism. The girl was a confirmed opium-eater, and this habit may have had some influence in delaying the operation of the poison. In other instances there have been great intermissions. In all cases in which arsenic enters the system from without, as by its application to the skin, or to ulcerated or diseased surfaces, the symptoms are rarely manifested until after the lapse of some hours or even days. Large doses of arsenic commonly prove fatal in from eighteen hours to three days. The average time at which death takes place is twenty-four hours; but the poison may destroy life within a much shorter period. There are many authentic cases reported in which death has occurred in from three to six hours. In 1845 the author met with a well-marked case of death from arsenic in five hours; and in another, which occurred in 1849, death took place in two and a half hours (Guy's Hosp. Rep., 1850, p. 183; see also "Ann. d'Hyg.," 1837, 1, 339). In 1891 a woman, æt. 77, died in five hours. Foster, of Huntingdon, met with the case of a child under three years of age which died within *two hours* from the effects of arsenic. The quantity taken could not be determined. The most rapidly fatal case which the author met with was that of a youth, æt. 17, who died in April, 1860, from the effects of a large dose of arsenic, the symptoms from which he suffered being of a tetanic character. The poisoning was the result of an accident at Ramsey, in the Isle of Man. The medical evidence at the inquest was to the effect that not more than *twenty minutes* had elapsed between the time at which deceased sat down to eat his supper, containing the poison, and his death. [This was a very doubtful case of death from arsenic.] In some instances death does not occur until long after the average period. In one case in which an adult swallowed about half an ounce, death did not take place for *fifty hours*, and it is remarkable that there was an entire absence of pain (*Med. Gaz.*, vol. 48, p. 446). In 1847, a man who had swallowed half an ounce of arsenic was admitted into Guy's Hospital. He died on the *seventh* day. It is obvious that a patient who recovers from the first effects of this poison may still die from exhaustion or other secondary causes many days or weeks after having taken it, even although the whole of the poison has been eliminated from the body. Thus in the case of Dr. Alexander, death took place on the *sixteenth* day, and although a large quantity had been taken, no arsenic was found in the body (*Med. Times and Gaz.*, 1857, 1, p. 389). In one instance in which arsenic was applied externally to the head the person did not die until the *twentieth* day.

On this part of the subject it is well to draw the reader's attention to the fact that arsenic and some of its compounds are well known to exist in two or three forms, some more, some less, soluble, and possibly, therefore, more or less irritating to the stomach. Again, it is known that arsenic has a tendency to produce fatty degeneration of tissues (muscles and other), and some of the delayed deaths may have been due to this effect persisting after the cause had ceased to act.

Symptoms.—In an **acute case of arsenical poisoning** by the mouth the individual usually first experiences faintness, depression, nausea, and sickness, with an intense burning pain in the region of the stomach, increased by pressure. The pain in the abdomen becomes more and more severe; and there is violent vomiting of brown turbid matter, mixed with mucus, and sometimes streaked with blood. These symptoms are followed by purging, which is more or less violent, and this may be accompanied by severe cramps in the calves of the legs; these are, however, often absent. The matters discharged from the stomach and bowels have had in some instances a yellowish colour, as it was supposed, from a partial conversion of the poison into sulphide, but more probably from an admixture of bile. The vomited matters are in some cases coloured with blood, and the mixture of blood with bile has often given to them a green or brown colour. In other cases, they may consist of a large quantity of mucus ejected in a flaky state and having a milky-white appearance, as if from admixture with the poison. The *colour* of the vomited matters may be blue or black when coloured arsenic has been taken, or the admixture of bile may render them of a deep green. The vomiting is in general violent and incessant, and is excited by any liquid or solid taken into the stomach. There is tenesmus (straining at stool), and the discharges by the bowels are frequently tinged with blood. There is a sense of constriction, with a feeling of burning heat in the throat, commonly accompanied by the most intense thirst. The pulse is small, frequent, and irregular; sometimes wholly imperceptible. The skin is cold and clammy in the stage of collapse; at other times it is hot. The respiration is painful from the tender state of the stomach. There is great restlessness, but before death stupor may supervene, with paralysis, tetanic convulsions, or spasms in the muscles of the extremities. In one instance trismus (lockjaw) appeared in three-quarters of an hour (Orfila, vol. 1., p. 449). Although pain is in general among the early and well-marked symptoms, arsenic appears in some cases to destroy sensibility. Thus it has been observed that, even when the stomach has been found intensely inflamed after death, the patient had not complained of pain during the time which she survived. [Simple gastritis is not necessarily painful.—Ed.]

It is not, however, in every case that all these symptoms are observed. Cramps in the calves may be absent; and there may be no vomiting or purging. In one case, where a woman died in three hours after taking arsenic in a pudding served at dinner, there was no vomiting nor purging. In two hours she was in a state of complete collapse, and at the time it was noticed that the conjunctivæ (the membranes of the eyes) were red (*Med. Times*, 1851, 2, p. 229). Vomiting and purging are nevertheless seldom both absent. The condition of the urine has been laid stress upon; but as it has been found normal, retained, suppressed, or abundant, no clinical importance can be attached to the increase or diminution of this secretion. The condition of the urine was much discussed in *R.* v. *Maybrick* (Liverpool Sum. Ass., 1889).

In October, 1891, a gamekeeper drank an unknown quantity of wine, accidentally contaminated with from five to six grains of arsenious acid per fluid ounce; and subsequently four other members of his family partook of the wine, in quantities varying from a mere taste in the case of a young child to half a tumblerful or more in the cases of the adults.

The man suffered from severe abdominal pains, persistent vomiting, and diarrhœa, and cramps in the calves of the legs, the feet, and the hands. He died in two days of acute gastro-enteritis. The child suffered somewhat from the effects of the irritant. The other three adults (young women), in about ten minutes, all had a burning sensation in the throat and gullet, vomiting, diarrhœa, abdominal pains, but no cramps in the limbs. On post-mortem examination of the deceased man, the signs of acute gastro-enteritis were visible, but none of the petechial ecchymosis of the mucous membrane of the stomach, which has by some observers been regarded as characteristic of arsenical gastro-enteritis. The above may be regarded as typical cases of acute arsenical poisoning.

Chronic Poisoning.—In the majority of accidental cases, and even in many of the homicidal ones (by the intent of the poisoner), however, the symptoms are not commonly of this severe and definitely gastro-intestinal character. In these cases, which may be termed chronic to distinguish them, the symptoms may be put into four groups.

(1) Gastro-intestinal symptoms of modified severity.
(2) Catarrhal symptoms about eyes, nose and mouth.
(3) Cutaneous rashes, with discolorations.
(4) Symptoms of peripheral neuritis.

Dr. Taylor thus described them in former editions. Should the person recover from the first effects, and the case be protracted, or should the dose have been small and administered at intervals, there will be inflammation of the conjunctivæ, with suffusion of the eyes, and intolerance of light, conditions which are, however, often present among the early symptoms above described. There is also irritation of the skin, accompanied by a vesicular eruption, which has been called *eczema arsenicale*. Sometimes this has assumed the form of nettle-rash or of the eruption attending scarlet fever, for which disease arsenical poisoning has been mistaken. Local paralysis, preceded by numbness or tingling in the fingers and toes, and other symptoms of nervous disorder, are also common consequences. Sir Thos. Stevenson has seen a case of arsenical poisoning in which repeated three-quarter grain doses of white arsenic were given with homicidal intent, followed by general paralysis beginning in the lower extremities, and gradually creeping upwards till the lower intercostal and other respiratory muscles were affected. The patient recovered under treatment. These paralyses are due to a form of neuritis identical with that resulting from alcoholism. Exfoliation of the cuticle and skin of the tongue, and falling off of the hair, have likewise been witnessed (case of the Turners, 1815, "Marshall," p. 119, Husemann's "Jahresbericht," 1871, p. 527). Salivation has been observed to follow, especially when small doses of the poison have been given for a length of time (*Med. Gaz.*, vol. 16, p. 790). Strangury and jaundice have been also noticed among the secondary symptoms ("Marshall on Arsenic," pp. 44, 111; *B. M. J.*, 1885, 1, p. 1246). Melanosis is rarely observed (*Correspondenzbl. f. Schweitzer Aertze*, 1890, No. 15). A well-marked case of slow poisoning by arsenic is recorded by Flandin ("Traité des Poisons, ou Toxicol.," t. 1, p. 510). It illustrates a not unfrequent form of secret murder, and it is well calculated to inspire caution in making a diagnosis from symptoms.

A woman put daily into the soup of her fellow-servant, a very small quantity of white arsenic in powder. Shortly after dinner this person was seized with vomiting which led to the rejection of the food and poison before the latter had caused any serious mischief. As this practice was continued at intervals for about six weeks, the stomach became exceedingly irritable; there was pain in the bowels, and the woman was much emaciated. There was also spitting of blood, with such a degree of nervous irritability that a current of air falling upon her, caused an attack of spasms and convulsions. When the patient found that she could not bear anything on her stomach, she left the place and passed two months in the country. Her health became gradually re-established there, and she returned to resume her usual occupations. The prisoner, however, renewed her attempts; and, to make sure of destroying life, gave to her one morning, in coffee, a large dose of white arsenic in powder: violent vomiting ensued, and the poison was expelled with the food taken at breakfast. Arsenic was detected in the vomited matter, and the explanation of the cause of the long previous illness became clear. Under treatment the patient recovered.

Such symptoms as those above described may be easily referred to chronic inflammation or ulceration of the stomach from natural causes, leading to perforation. There are many anomalous cases on record, in which the symptoms have diverged so much from the ordinary course as to embarrass medical practitioners. For some of these, the reader is referred to a paper by Ogston, *Med. Gaz.*, vol. 47, p. 181; also to the author's work "On Poisons," 2nd ed. p. 363; and Husemann's "Jahresbericht," 1872, p. 481.

At Hyères, in 1888, an alarming outbreak of arsenical poisoning occurred, the poison having been accidentally introduced into wine, which was drunk by many persons for a considerable time. The symptoms at the outset were those of dyspepsia, with nausea, vomiting, and purging; but nausea and vomiting were not invariable. The gastro-intestinal symptoms generally disappeared in a few days. There was dryness of the mouth, loss of appetite, a sense of constriction at the pit of the stomach, and wasting. Bronchial irritation was marked, with scanty secretion of mucus. There were pains in the limbs and œdema of the joints. The patellar reflexes were weakened or abolished. Wandering pains were felt in various regions, and headache, and the sense of touch was diminished. A garlicky taste was felt in the mouth, but the sense of taste was not diminished. The vision was disturbed, and the conjunctiva of the eye was inflamed. There were scaly eruptions on both surfaces of the hands and feet. Of sixty-three reported cases, thirty were slight, eighteen serious, and fifteen fatal.

In any one group of these accidental cases the *symptoms* produced are of a more or less uniform character, showing their origin from a common cause. In the cases derived from wall-papers they were as follows:—dryness and irritation of the throat, dry cough, irritation of the mucous membrane of the eyes and nostrils, languor, headache, loss of appetite, nausea, colicky pains, numbness, cramp, irritability of the bowels attended with mucous discharges, great prostration of strength, sleeplessness, a feverish condition, and wasting of the body. These symptoms may not have all presented themselves in any one case. The connection of the symptoms with this cause appears to have been in some instances clearly established by the fact that after the removal of the paper, especially from bedrooms, the symptoms have disappeared (*Med. Times and Gaz.*, 1871, 1, p. 674).

As regards the diagnosis of such cases the following remarks are taken from the *B. M. J.* Epit., p. 9, July 18th, 1903.

"Ferrannini (*Rif. Med.*, June 3rd, 1903), after discussing the ordinary symptoms of poisoning by arsenic, refers briefly to some of the rarer forms. In addition to paralysis one may get ataxia, which may be associated with other tabetic symptoms—for example, absence of knee-jerks, Romberg's sign, lightning pains, anæsthesia, and ocular disorders (diplopia, amaurosis, absence of pupillary reflex). This ataxic form is due to a polyneuritis, and not a myelitis. Tremor may also be due to arsenical poisoning. In differentiating between alcoholic and arsenical poisoning, the following data should be borne in mind. In the first place alcoholic neuritis is rarely due to acute alcohol poisoning, but usually occurs in the chronic drinker, and the delirium which opens the scene is the equivalent of the acute gastro-enteritis of arsenical poisoning. In alcoholic dyspepsia chronic gastritis with morning catarrh and pyrosis are the common type. In arsenicism you get insomnia, in alcoholism terrifying dreams. The sensory disturbances in alcoholic paralysis are usually less severe than in arsenical poisoning. Desquamation is peculiar to arsenical poisoning, whilst psychical disorders prevail in alcoholism. In arsenical poisoning the motor disorders, the atrophy and deformities chiefly affect the fingers and toes; in alcoholic poisoning the forearm and calf are more prominently affected, and it is the wrist and ankle articulations rather than the phalangeal which share in the deformity. The author then relates three cases of arsenical paralysis occurring in the same family (mother and two sons), and presenting identical symptoms, due to eating flour made from lathyrus beans (vetch). Chemical analysis showed that it contained a considerable amount of arsenious anhydride. In each case it was the lower extremities that were paralysed. Sensory disturbances (itching, numbness) were present in the palms of the hand and soles of the feet. Some static ataxia was present. The tendon reflexes were abolished. Sensation normal. There was considerable wasting of the forearm and leg."

Treatment.—In the chronic cases the only effectual treatment is to stop the ingress of the poison and then treat symptoms on general medicinal lines, tonics, electricity, etc. In the acute cases evacuate the stomach with tube, or emetic, and then give *freshly precipitated ferric oxide*. This can be prepared by adding ammonia water, or a solution of potassium carbonate, to the tincture of iron perchloride; the precipitate is strained off and administered suspended in water. Calcined magnesia may be substituted if ferric oxide cannot be obtained, Demulcents and subsequently morphine should be given. External warmth will be required (Mann).

Post-mortem Appearances.—The striking changes produced by arsenic are generally confined to the stomach and bowels. They are commonly well marked in proportion to the largeness of the dose, and the length of time which the person has survived after taking the poison. Our attention must be first directed to the *stomach*. Arsenic seems to have a specific effect on this organ, and the mucous membranes generally: for, however the poison may have entered into the system, whether through a wounded, diseased, or ulcerated surface, or by the act of swallowing, the stomach has been found inflamed. The mucous membrane of the stomach, which is often covered with a layer of mucus, mixed with blood or bile, and with a thick, white, pasty-looking substance containing arsenic, is commonly found red and inflamed in dotted or striated patches: the colour, which is of a dull or brownish red, becomes brighter on exposure to the air: at other times it is of a deep crimson hue, interspersed with black-looking lines or patches of altered blood. The redness is usually most strongly marked at the greater end; in one case it may be found spread over the whole mucous surface, giving to it the appearance of red velvet; in another it will be chiefly seen on the prominences or folds of the membrane. Often there is punctated ecchymosis, though this is not invariable. In one instance the author found the coats thickened and of a gelatinous consistency, without any marked inflammatory redness.

The stomach has been found highly inflamed in a case which proved fatal, in 1863, in *two hours*. Thus it would appear that inflammation of the mucous membrane may be well marked within a very short period.

A woman, æt. 24, retired to her bedroom after dinner, at two o'clock. At three o'clock she was not suffering from any apparent illness. At half-past four she called her sister, and then it was found that she had swallowed a quantity of arsenic. There was then no sickness. After this, she was sick once, and purged once, but complained of no pain. She drank some tea, but almost immediately became collapsed, and seemed to those who were with her to be falling into a fainting fit. She died before six o'clock, and was sensible to the last. She could not have taken the poison more than two hours before she died.

On inspection the day following, the whole mucous membrane of the stomach was intensely inflamed, presenting a dark scarlet colour, with broad livid patches. Upwards of an ounce of solid arsenic was found in a pasty state on the mucous membrane of the stomach, which was raised, thickened, and velvety. This case shows not only that there may be extensive morbid changes in the dead body within a short period after the taking of the poison, but that, with an unusually large dose, the symptoms of vomiting, purging, and pain may be slight and bear no proportion to the quantity of poison taken. Blood of a dark colour may be effused in various parts within the folds, or beneath the lining membrane—an appearance which has been mistaken for gangrene. A raised circular or oval patch of false membrane with an intensely red border, and with arsenic upon its surface, may be sometimes seen upon the inner coat.

The stomach often contains a mucous liquid of a dark colour tinged with blood. The coats are sometimes thickened in patches, being raised up into a sort of fungus-like tumour, with arsenic embedded in them: at other times they have been found thinned. The mucous membrane may be found ulcerated, and still more rarely gangrenous. The gangrenous appearance is possibly an error of observation. Ulceration of the mucous membrane, as the result of the action of arsenic, has been found as early as ten hours after the poison had been taken. Perforation of the coats is so uncommon a result of arsenical poisoning, that there are but few instances on record. Murray Thompson met with a case in which there was on the mucous coat of the stomach a black hardened patch the size of the palm of the hand.

Various appearances are said to have been met with in the lungs, heart, brain, liver, kidneys, and urinary organs; but they do not appear to be so characteristic of arsenical poisoning as to admit of medico-legal use in enabling a medical man to distinguish poisoning from disease. It is to the stomach and intestines that he must look for the basis of reliable evidence in regard to appearances after death. An ecchymosed condition of the lining membrane of the left ventricle of the heart and of its pericardial surface, fatty degeneration of the liver, and bloodlessness of the body, have been met with in cases of acute arsenical poisoning (Horn's *Vierteljahrsschrift*, 1862, 2, 345). Fatty degeneration of the liver and other organs is ocasionally observed (*R.* v. *Webster*, Ed. High Ct. of Just., February, 1891).

In a few instances the mouth, throat, and gullet have been found inflamed, but in general there are no changes in these parts to attract particular attention. The mucous membrane of the small intestines may be inflamed throughout, but commonly the inflammatory redness is confined to the upper part or to the duodenum, especially to that portion which joins the stomach. Of the large intestines, the rectum appears to be the most prone to inflammation. The liver, spleen, and kidneys present no appearances which can be connected with the action of arsenic, although these, like the other soft organs, may become receptacles of the absorbed poison. It is worthy of observation in relation to the known antiseptic properties of arsenic, that the parts especially affected by the poison (the stomach and bowels) occasionally retain the well-marked characters of irritant poisoning for a long time after death. Absorbed arsenic does not, however, appear to markedly prevent the decomposition of the soft organs in which it is deposited.

So long as the case is acute the exact method, or rather portal, of entrance of the poison seems to have very little influence in preventing the stomach from being attacked. Thus in some cases of external application of baby's powder contaminated with arsenic the remarkable features were these: no symptoms appeared until after the fourth day, and then only great thirst; there was slight purging with cramps on the eighth day, and death took place on the tenth, without any vomiting. Arsenic was found in the stomach and contents, and its presence there might have led to an erroneous inference of its having been criminally administered by the mouth. It was, however, present merely in traces, and obviously the result of elimination. The nature and mode of occurrence of the symptoms were also opposed to any other presumption. That absorbed arsenic may be thus transferred from the blood to the stomach and intestines, has been distinctly proved by the experiments of Pavy and the author (Guy's Hosp. Rep., 1860, p. 397).

Another female infant died fourteen days after birth. In this case a similar violet-powder was applied as usual. Within a short time of the application the skin became red, and vomiting and purging set in, and continued till death. On section the abdominal parietes showed much inflammatory action; they were thickened and adherent to the viscera. The rectum was highly inflamed; the kidneys and spleen were much congested; and the liver was very slightly congested. Upwards of three grains of arsenic were extracted from the viscera.

In the more chronic cases the post-mortem appearances present no constant nor characteristic signs discernible by the eye: the only hope of detecting such cases lies in suspicion followed by analysis.

Of course, if some of the coloured arsenical compounds have been administered, it is possible that there may be coloured particles visible in the alimentary canal (*vide* above, p. 346).

Analysis.—Owing to the fact that arsenic is one of the few poisons which not only can but have been used in historical cases of chronic poisoning, a halo of romance and mystery has sprung up round this substance which led Dr. Taylor to record everything reported on known cases. We are now in a much better position, since the report of the Manchester Commission, to collate and explain much that was to Dr. Taylor mysterious and almost supernatural, and even to reconcile many points in apparent conflict in his estimation.

Thus we may note. Arsenic is **not an accumulative poison**; it is temporarily deposited in the organs after absorption, but is rapidly eliminated by the urine and other secretions; and in two to three weeks, if the person survives, the whole of it may be removed from the body. In 1891, Sir T. Stevenson found it in the urine for four days only after the taking of a poisonous dose of arsenic, and consequently the amount found on analysis need not by any means correspond in any degree with the amount which was administered.

The same report (above) would seem also to show that though it is true that arsenic is not a natural constituent of the body at birth, nevertheless there are so many unsuspected sources of arsenic, and means by which it may enter the body in minute quantities (and analysis can detect such a minute fraction of a grain), that caution is necessary in swearing in a given case that arsenic was the cause of death. So strongly is this now felt, that in 1904 a man was set free in France who had been condemned some years ago on evidence of this sort to a long term of imprisonment. The case is thus reported in the *Daily Telegraph*, February 29th, 1904.

> The Judicial Committee of Revision of Trials has allowed the chemist Danval, who received a free pardon eighteen months ago, to bring on a new trial to clear himself completely. He was found guilty twenty-five years ago of the murder of his wife by having poisoned her with arsenic, and was sentenced to transportation for life. The evidence on which Danval was found guilty was purely scientific, and

his application has been allowed solely on account of the fact that later scientific investigation has proved the evidence in question to have been erroneous. At the trial, twenty-five years ago, all the expert witnesses swore that the quantity of arsenic, one milligram (·015 of a grain, less than one-sixtieth), found in the corpse of Danval's wife at the post-mortem could not possibly have existed in the system under natural circumstances. The inference drawn was, of course, that the arsenic had been administered by Danval, and it was largely on this evidence that he was found guilty, with, however, extenuating circumstances. Since the trial the researches of various doctors and physicists, including MM. Armand Gautier, Béhal, and Gabriel Bertrand, have, on the contrary, conclusively demonstrated that the quantity of arsenic mentioned can and frequently does exist in the human body in a normal state. Presumption is thus set up in favour of Danval's defence, which was that the presence of arsenic in his wife's remains was explained by her having been in the habit of taking certain medicines. The decision of the Committee of Revision has been entirely grounded on the recent scientific conclusions above-mentioned.

We may sum the matter up briefly by saying that to prove death by and from arsenic some symptoms known to be possibly caused by arsenic must have been observed before death, and leading up to death, and then there must be unequivocal proof that some rational quantity of the metal was found in the viscera, or good evidence of such a lapse of time after the administration of the last dose as to give a satisfactory explanation of its possible absence. But finally it must be remembered that a person may die of a disease for which arsenic is quite legitimately being administered.

Again it has been supposed that the *quantity* of arsenic found in the stomach and bowels may throw a light on the question, whether the poison has been taken voluntarily with the intention of committing suicide, or whether it had been criminally administered by another. There is no doubt that a much larger dose may be taken by a suicide than could be secretly administered by a murderer. Suicides have been known to take as much as two tablespoonfuls, or *one thousand grains*, of arsenic.

In a case of suicide by arsenic, which occurred at the Bristol Infirmary in 1872, a larger quantity had been taken. On a post-mortem examination, four ounces of arsenic were found in the stomach, of which two and a half ounces were in one mass. The woman, when brought to the hospital, was in a state of complete collapse. Death took place rapidly (*Pharm. Jour.*, 1872, p. 75).

In the case of L'Angelier (*R.* v. *Madeline Smith*, Ed. High Court of Justiciary, June and July, 1857), Penney stated in evidence that the quantity of arsenic which he found in the stomach and contents of the deceased amounted to eighty-eight grains, and that some part of this was in hard, gritty, colourless, crystalline particles. As there was arsenic in the contents of the intestines, and there had been vomiting and purging, it is obvious that the deceased must have taken a very large dose of the poison; and it was one of the suggested difficulties of this case, to determine how the deceased could have taken the poison in so large a quantity unknowingly. The quantity found, however, amounted to no more than half a teaspoonful; and admitting that one half of the dose taken had been ejected, the question resolves itself into this: whether a teaspoonful of arsenic might not have been homicidally administered in chocolate, gruel, or some thick liquid, or in a state of admixture with solid food (cake). Although it is unusual to find half a teaspoonful of arsenic remaining in the stomach in a case of homicidal administration, it is impossible to admit that this fact is inconsistent with an act of murder.

Sir T. Stevenson has known an ounce of arsenic homicidally put into a pint of rice pudding. The pudding was eaten without suspicion (*R.* v. *Leffley*, Lincoln Ass., November, 1884). A man half intoxicated might be thus poisoned; and if death took place in a few hours, even a larger quantity than that which was here found might remain in the stomach. Christison set this question at rest by the publication of a case in which a man was homicidally destroyed by arsenic, and the quantity found in the stomach after death was from ninety to one hundred grains. The man had survived from five to seven hours, and there had been frequent vomiting of a yellowish or greenish coloured liquid during this period. The arsenic was administered in whisky-punch with sugar, and it was kept in suspension by constant stirring (*Edin. Month. Med. Jour.*, December, 1857, p. 481). In *R.* v. *Dodds* (Lincoln Ass., December, 1860), the prisoner was charged with administering arsenic to the deceased with intent to murder. The quantity stated to have been found in the stomach was 150 grains. There was no reason to suppose that he had taken the poison with suicidal intention; but, on the contrary, there was strong evidence to presume that it had been administered to him with a design to destroy life. A woman, named Alice Hewitt, was tried (*R.* v. *Hewitt or Holt*, Chester Winter Ass., 1863), and convicted of poisoning her mother with arsenic. Although the symptoms of irritant poisoning were very clearly marked, a medical man who attended her certified the cause of death as gastro-enteritis. Eleven weeks after the burial of the deceased, the body was exhumed and examined. It was proved that shortly before her mother's death, the prisoner had purchased a quarter of a pound of arsenic, and there was clear evidence of administration, a large dose having been given to the deceased in liquid shortly before her death. The inspection revealed the extraordinary fact that 154 grains of solid arsenic were found in the stomach alone. It had been partially converted into sulphide as a result of putrefactive changes, and it was observed that the liver, omentum, and the right side of the heart were thickly coated with yellow arsenious sulphide. In reference to this coloration, the front of the spinal column behind the stomach has been seen tinged of a deep yellow from arsenic which had escaped through the coats of this organ.

Dr. Taylor thought it worth his while to lay stress on the fact that arsenic had been found in bodies that had been buried for eight and even fourteen years, but considering that arsenic is a metallic element there seems to us nothing wonderful in such a fact, on the contrary, it would seem more miraculous if no arsenic were found even after a thousand years if the remains had not been disturbed in any way.

The condition of the arsenic found in a dead stomach should, if possible, be noticed. A witness should be prepared to say whether it is in fine powder or coarse fragments; whether it is mixed with soot or indigo, or whether it is in the ordinary state of white arsenic. These points may be material as evidence in reference to proof of possession, of purchase, or administration.

Chemical Analysis (*Arsenic as a solid*).—In the simple state, *white arsenic* may be identified by the following properties:—1. A small quantity of the powder, placed on platinum-foil, is entirely volatilised at a moderate temperature (400° F.) as a white vapour. Should there be any residue, it is impurity; sometimes plaster of Paris or chalk is found mixed with it. If a small portion of the white powder is very slowly heated in a glass tube of a narrow bore, it will be sublimed without melting, and form a ring of minute octahedral and tetrahedral crystals, remarkable for their lustre and brilliancy. Under a microscope magnifying 250 diameters, the appearance of these crystals is remarkably beautiful and characteristic; one not exceeding the four-thousandth of

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an inch in diameter may be easily recognised by the aid of this instrument. They may be measured even to the sixteen-thousandth of an inch in diameter. It will be observed in these experiments that white arsenic in vapour possesses no odour. 2. On boiling a small quantity of the powder in distilled water, it is not readily dissolved, but it partly floats in a sort of white scum, while a part becomes aggregated in lumps at the bottom of the vessel. It requires long boiling in order that it may be dissolved and equally diffused through water. This property of arsenic has given rise to some important questions on criminal trials. The floating of arsenic takes place whether the water is hot or cold, and whether the water is added to the poison or the poison to the water (see the case of *R.* v. *Smith*, Wells Lent Ass., 1869). This property has attracted attention, and in one instance was the means of saving life. 3. When the powder is treated with a weak solution of sulphide of ammonium in a watch-glass, there is no change of colour, as there is with most metallic poisons; on warming the mixture the white powder is dissolved; and on continuing the heat until the ammonium salt is expelled a rich yellow or orange-red film is left (arsenious sulphide), which is soluble in alkalies, and insoluble in hydrochloric acid. 4. Heated on platinum-wire in a smokeless flame, the powder imparts to it a pale blue colour, while it is volatilised in white fumes. 5. Another test is stannous chloride in hydrochloric acid. The mixture is brought to the boiling point, and it should remain colourless. If the hydrochloric acid contains a trace of arsenic, the liquid will acquire a light brown colour. On adding a minute quantity of solid arsenious acid, this is dissolved, and metallic arsenic is deposited in the form of a brown or brownish-black precipitate. A salt of antimony is not thus affected.

Reduction process.—When a small portion of the powder, *i.e.*, from one-fourth to one-twentieth part of a grain, is heated with some reducing agent containing carbon, such as *soda-flux* (obtained by incinerating acetate or tartrate of sodium in a close vessel), in a glass tube about three inches long and from one-eighth to a quarter of an inch in diameter, it is decomposed: a ring of metallic arsenic of an iron-grey colour is sublimed and deposited in a cool part of the tube. A mixture of one part of cyanide of potassium with three parts of dry (anhydrous) carbonate of sodium forms an excellent flux for the reduction of arsenic. The materials and tube should be well dried. About two or three parts of either flux to one part of arsenic will be found sufficient. In the absence of these fluxes powdered ferrocyanide of potassium may be used in a similar proportion. After heating, a minute trace of arsenic remains in the flux. During the reduction there is a perceptible odour, resembling that of garlic, which is possessed by metallic arsenic only whilst undergoing oxidation. This *odour* was at one time looked upon as peculiar to arsenic, but little reliance is now placed on it as a matter of medical evidence—it is a mere accessory result. In this experiment of reduction there are frequently two rings deposited in the tube:—the upper and larger ring has a brown colour, and appears to be a mixture of finely divided metallic arsenic and arsenious acid; the lower ring is small, and consists of the pure metal. In order to determine the *weight of the sublimate*, the glass tube should be filed off closely on each side of the metallic ring, and weighed in a delicate balance; the sublimate may then be driven off by heat, and the piece of glass again weighed: the difference or loss represents the weight. By heating gently the pulverised tube with the sublimate in another tube of larger diameter, the metallic arsenic, during volatilisation, forms octahedral crystals of arsenious acid, which, after examination by the microscope, may be dissolved in a few drops of water, and tested by one or more of the liquid reagents. The metallic sublimate, or the crystals produced from it, may be further subjected to the following process:—Break the glass on which the sublimate is deposited, into fragments, and digest these in a few drops of fuming nitric acid, previously proved to be free from arsenic. The sublimate is thereby converted into *arsenic acid.* The acid solution should be evaporated to dryness: the white uncrystalline residue obtained should be dissolved in a few drops of distilled water, and a strong solution of nitrate of silver, or of the ammonio-nitrate, added in small quantity to the residue. A brick-red coloration indicates arsenic acid, and thus proves incontestably that the sublimate was of an arsenical nature.

The upper or brownish-looking sublimate may be readily converted into one of the pure metal, by gently heating it in the flame of a spirit lamp. Arsenious acid is then volatilised, and an iron-grey deposit of metallic arsenic appears. If the heat is continued, the whole of the metallic sublimate is volatilised and deposited in a cool part of the tube, in transparent and colourless octahedra, or modified octahedra, of arsenious acid. This is the special character of an arsenical sublimate: it may be thus distinguished from sublimates of all metals or non-metals. The lower metallic sublimate procured by reduction may appear not in an annular form, but in detached isolated particles of a somewhat globular shape. These are of an iron-grey colour, quite unlike sublimed mercury, and when examined by the microscope it may be seen that they consist of crystalline masses, that they are angular, and not strictly spherical. This sublimate is sometimes produced in the last stage, when the residue in the tube is strongly heated.

The *process of reduction*, with the corroborative results above mentioned, is, when thus applied, conclusive of the arsenical nature of the substance under examination.

Arsenic in solution in water. Liquid tests.—The solution of arsenious acid is clear, colourless, possesses scarcely any perceptible taste, and has but a feebly acid reaction. In this state, we should first evaporate slowly a few drops on a glass slide, when a crystalline residue will be obtained. On examining this with a microscope, it will be found to consist of numerous minute octahedral crystals, presenting triangular surfaces by reflected light.

1. *Silver test.*—On adding to the solution *ammonio-nitrate of silver*, a pale yellow precipitate of arsenite of silver falls;—changing under exposure to daylight, to a greenish-brown colour. The test is made by adding to a strong solution of nitrate of silver, a weak solution of ammonia, and continuing to add the latter until the brown oxide of silver, at first thrown down, is almost re-dissolved. The yellow precipitate is soluble in nitric, tartaric, citric, and acetic acids, as well as in ammonia. It is not dissolved by potash nor by soda.

2. *Copper test.*—On adding to a solution of arsenic, *ammonio-sulphate of copper*, a light green precipitate of arsenite of copper is formed, the

tint of which varies according to the proportion of arsenic present, and the quantity of the test added: hence if the arsenic is in small proportion, no green precipitate at first appears; the liquid simply acquires a blue colour from the test. In less than an hour, if arsenic is present, a bright green deposit is formed, which may be easily separated from the blue liquid by decantation. This test is made by adding ammonia to a weak solution of sulphate of copper until the bluish-white precipitate, at first produced, is nearly re-dissolved: it should not be used in large quantity if concentrated, as the deep blue colour tends to obscure or conceal the green precipitate formed. The precipitated arsenite of copper is soluble in all acids, mineral and vegetable, and in ammonia, but not in potash or soda. If a small quantity of the blue ammoniacal solution of this precipitate is poured over a crystal of nitrate of silver, a film of yellow arsenite of silver will appear around the crystal. If a strong solution of nitrate is added to the blue liquid, nearly neutralised by diluted sulphuric acid, a yellow precipitate of arsenite of silver is also produced. Thus the silver and copper tests may be employed with the same quantity of liquid. The *dried* precipitate of arsenite of copper, when slowly and moderately heated in a well-dried reduction-tube, yields a ring of octahedral crystals of arsenious acid—black cupric oxide being left as a residue.

3. *Sulphuretted hydrogen test.*—Sulphide of ammonia gives no precipitate in a solution of arsenic until an acid has been added, by which property arsenic is known from most metallic poisons. On adding dilute hydrochloric acid, a bright lemon-yellow coloured precipitate is thrown down (orpiment or arsenious sulphide). It is better, however, to employ, in medico-legal analysis, a current of washed sulphuretted hydrogen gas, which is easily procured by adding to ferrous sulphide, in a proper apparatus, a mixture of one part by volume of strong hydrochloric acid and one part of water. The arsenical liquid should be slightly acidulated with pure diluted hydrochloric acid, *before* the gas is passed into it: and care should be taken that it is not alkaline. The yellow compound is immediately produced if arsenic is present, and it may be collected after boiling the liquid sufficiently to drive off any surplus gas. The precipitation is likewise facilitated by adding to the liquid a solution of chloride of ammonium. The yellow precipitate is known to be arsenious sulphide by the following properties:—1. It is insoluble in water, alcohol, and ether, as well as in diluted hydrochloric acid, and vegetable acids: but it is decomposed by strong nitric and nitro-hydrochloric acids. 2. It is dissolved by potash, soda, or ammonia: forming, if no organic matter is present, a colourless solution. 3. When dried and heated with two or three parts of a mixture of carbonate of sodium and cyanide of potassium, it gives a sublimate or metallic arsenic. Unless these properties are possessed by the yellow precipitate formed by sulphuretted hydrogen in an unknown liquid, it cannot be a compound of arsenic. On the other hand, when these properties are possessed by the precipitate, it must be arsenic, and can be no other substance.

4. *Marsh's process.*—The action of this test depends on the decomposition of the soluble compounds of arsenic by nascent hydrogen, evolved from the action of dilute sulphuric or hydrochloric acid on zinc. The materials should be first proved to be free from arsenic. The

apparatus is of the most simple kind, and is so well known as to need no description. The arsenic to be introduced is best dissolved in water, by boiling it either with or without the addition of a few drops of potash or hydrochloric acid. The metallic arsenic combines with the hydrogen, forming arseniuretted hydrogen gas, which possesses the following properties:—1. Filtering paper wetted with a solution of nitrate of silver is immediately blackened by the gas—the silver being reduced to the metallic state. Lead-paper is not changed in colour, unless sulphuretted hydrogen is also present. 2. It burns with a pale bluish-white flame, and thick white smoke (arsenious acid). 3. A slip of glass, or of white porcelain, held in the flame near the point (for not too long a time) acquires a dark stain from the deposit of metallic arsenic upon it. This deposit presents a bright metallic lustre in the centre, a white film of arsenious acid on the outside, and between the two a dark ring of a pulverulent substance, which, when viewed by transmitted light, is hair-brown in colour towards the margin, but opaque in the centre. In order to determine the arsenical nature of the deposits, the following plan may be adopted. Several of them should be received and accumulated in small porcelain capsules, held over the burning gas. To one, add a solution of chlorinated lime: the arsenical deposit is immediately dissolved. To a second, add a solution of sulphide of ammonium: the metallic deposit is detached, but not perfectly dissolved; yet on evaporation it yields a pale yellow film of arsenious sulphide. To a third, add a few drops of fuming nitric acid, when the deposit is dissolved. Evaporate the acid solution gently to dryness; carefully neutralise the residue, and add one or two drops of a strong solution of nitrate of silver, when a brick-red stain or a dark-red precipitate of arseniate of silver will be produced. 4. When passed through a narrow glass tube, heated to dull redness, a hair-brown mirror of metallic arsenic is deposited a little beyond the point at which the heat is applied, and this deposit is soluble in a solution of chlorinated soda or lime.

5. *Reinsch's process.*—In the application of this process, the liquid suspected to contain arsenic, or the solid dissolved in distilled water, is boiled with about one-sixth of its volume of *pure* hydrochloric acid (proved to be free from arsenic), and a small slip of copper is then introduced. A slip of polished copper-foil about a quarter of an inch square, attached to the end of a fine platinum wire, may be employed for the experiment. The copper must be first proved to be free from arsenic, as this is a very common contamination of commercial copper in the form of foil, gauze, or wire. Copper gauze and wire generally contain arsenic. Copper of a high degree of purity is, however, now a commercial article. Pure electrolytic copper, free from arsenic, can also be procured in the form of thin sheet or foil. If arsenic is present in the liquid, even in small quantity, the polished copper acquires either immediately or within a few minutes, an iron-grey metallic coating from the deposit of this metal. This is apt to scale off if the arsenic is in large quantity, or if the liquid is very acid, or long boiled. Remove the coated slip of copper, wash it successively in water, alcohol, and ether, dry, and gently heat it in a reduction-tube, when arsenious acid will be sublimed in minute octahedral crystals: if these should not be apparent from one piece of copper, several may be successively

introduced. When the quantity of arsenic is very small, the polished copper merely acquires a faint violet, grey, or bluish tint. The deposit is in all cases materially affected by the degree of dilution, and sometimes it will appear only after the liquid has been much concentrated by evaporation. We are not obliged to dilute the liquid in the experiment, and there is no material loss of arsenic, as in Marsh's process: the whole may be removed and collected by the introduction of successive portions of pure copper. This process is extremely delicate, and the results are speedily obtained. Among the cautions to be observed are these:—(1) not to employ too large a surface of copper in the first instance; and (2) not to remove the copper from the liquid too soon. When the arsenic is in minute quantity, and the liquid is much diluted, or not sufficiently acidulated, the deposit sometimes does not take place for half an hour. If the copper is kept in for an hour or longer, it may acquire a dingy tarnish from the action of the acid and air. There is one corroboration required. The copper with the deposit upon it should be well dried, cut into small pieces if necessary, and introduced into a *dry* and perfectly clean reduction-tube. The application of a gentle heat by a spirit lamp will cause the metallic arsenic to be volatilised as white arsenious acid, which is deposited in a cool part of the tube, in the form of octahedra or of the derivatives of the octahedron. When examined by a quarter-inch power under the microscope, these crystals may be seen and recognised by their shape up to the sixteen-thousandth of an inch in width. The smaller the crystal the more perfect the form. If the copper with the deposit, and the tube, has not been well dried, the angularity of form is not distinct. These crystals may be tested by the processes already described.

The following is a simple method of detecting arsenic in copper. Add to pure hydrochloric acid, diluted with six parts of water, one or two drops of a weak solution of ferric sulphate or chloride. Boil the acid liquid and introduce the copper, well cleaned and polished, into the boiling liquid. Arsenical copper acquires a dark tarnish, while the non-arsenical copper retains its red colour under these circumstances. It will be found from this experiment that copper in the state of gauze or fine wire generally contains arsenic. This would present no obstacle to the detecting of arsenic by it, provided the copper gauze were not dissolved. Arsenic can only be separated from its copper alloy by the destruction of the alloy and the solution of the two metals.

The mere fact that a grey deposit is formed upon pure copper when boiled in the liquid under examination after acidulation with pure hydrochloric acid, affords no absolute proof of the presence of arsenic. Other metals, *e.g.* antimony, mercury, silver, and bismuth, all yield deposits with Reinsch's test; and the grey deposit yielded by bismuth may readily be mistaken for that of arsenic. The volatility of the arsenical deposit, the crystalline nature of the sublimate, and its reaction when treated successively with nitric acid and nitrate of silver, must in all cases be ascertained before it is concluded that the deposit is arsenical.

In consequence of the errors into which faulty methods of employing Reinsch's test have led, its reliability has been much discredited; and though in skilful hands the results obtained by it are trustworthy, it would perhaps be unsafe to rely upon it in an important criminal investigation. It may be conceded that Marsh's process will detect a smaller quantity of arsenic than the process of Reinsch; but the latter, when the quantity of liquid is small, and pure materials are used, will detect the one-hundred-and-fiftieth or the two-hundredth part of a grain of the poison. It appeared to the author that in a criminal case it would not be safe to depose to the presence of arsenic from Marsh's process alone, when the quantity of poison was *too small* to admit of separation or corroboration by the process of Reinsch. Conversely the results of Reinsch's should be corroborated by those of Marsh's process. It was this over-reliance on the extreme delicacy of Marsh's process in researches where it admitted of no corroboration whatever, that led Orfila to assert that arsenic was a natural constituent of the human body (*vide* also the report of the Arsenic Commission, p. 481).

Arsenic in solids or liquids containing organic matter.—In testing *solids* generally for arsenic, we may employ the process of Reinsch as a preliminary test. The solid is boiled in water acidulated with from one-fourth to one-sixth of its volume of pure hydrochloric acid, until it is either dissolved or its structure broken up. A small portion of pure polished copper is then introduced. In a few minutes, if arsenic is present—even to the extent of the thousandth part of a grain—there will be a metallic deposit on the copper, and this will yield crystals when heated in a tube. *Liquids* suspected to contain arsenic may be treated in a similar manner. Water is not required; the liquid is simply acidulated with one-sixth part of pure strong hydrochloric acid. If the solution of the organic solid or the organic liquid is not deeply coloured, the stannous chloride test may be employed in place of the process of Reinsch. Less than the sixtieth part of a grain, even under considerable dilution, may be thus readily detected. It thus reveals traces of arsenic in ordinary sulphuric and hydrochloric acids.

The arsenic may be mixed with the organic liquid in the form of heavy lumps or powder. The great specific gravity of this substance allows of the liquid being poured off, and the sediment collected. When washed and dried, it will be found to be crystallised. It should be weighed, and then tested by the processes elsewhere described. Let us assume that the organic liquid is milk or beer, it will be necessary to determine whether any arsenic is dissolved in it. Filter a portion; place it in a dialysing tube and immerse the mouth of the tube in distilled water. In a few hours the arsenic will have traversed the membrane, and will be found in a clear and nearly colourless solution in the water. The fluid tests may be then applied to this liquid for the detection of arsenic. They should never be applied directly to coloured organic liquids.

Precipitation as sulphide.—When arsenic has been introduced into an organic liquid in large quantity, it may be precipitated as sulphide by a current of washed sulphuretted hydrogen. The liquid should be boiled, filtered, and acidulated with pure hydrochloric acid before passing the gas into it. When precipitation has ceased, it should be again filtered, the precipitate collected, washed, dried, and weighed. By operating on a measured portion of the solution, the amount of white arsenic may be determined, approximately, by the weight of the yellow sulphide obtained—five parts by weight of sulphide being equal to four parts of white arsenic, nearly. The properties of the yellow precipitate should be verified according to the methods mentioned above. In some cases arsenic may be present, but in a quantity too small to be precipitated as sulphide by sulphuretted hydrogen. In others the presence of certain substances may interfere with or prevent precipitation. The presence of any free alkali in a liquid prevents the formation of a precipitate.

When white arsenic is found, in powder, as a sediment in organic liquids, it is obvious that it must have been taken in the solid state, and, although mixed with a liquid or solid, still in an undissolved form. If found only dissolved, it may have been taken either in solution or in a solid form—the dissolved portion being part of the solid taken up by the fluids of the stomach, and the remainder having been expelled by vomiting and purging. This question was of importance in *R.* v. *Sturt* (Lewes Lent Ass., 1863). The deceased, in this case, died from the effects of arsenic in powder, administered, it was believed, in a mince-pie. It was suggested that the poison might have been swallowed in ginger-beer, but then it could not have been in a state of solution: it must have been mechanically mixed with the liquid. The judge who tried this case was apparently not aware of any difference existing between the actual solution and the mechanical suspension of a solid in a liquid.

Distillation process.—When the poison is in so small a quantity that it does not admit of precipitation by sulphuretted hydrogen, and no solid particles of arsenic are found in the stomach, in its contents, or in any article of food, another method may be resorted to for detecting its presence. This method equally applies to the detection of arsenic deposited as a result of absorption in the soft organs of the body, as in the liver, kidney, or heart, and to arsenic in all its forms, except the pure insoluble sulphide or orpiment. Although, after long interment, white arsenic passes, more or less rapidly, into the state of yellow sulphide as a result of chemical changes during putrefaction, the conversion is generally only partial. The only condition for success is, that the substance, whether food, blood, mucus, the liver, or other organ, should be first thoroughly dried, either by exposure to a current of air, or in a water-oven. The dried solid should then be broken into small portions and placed in a flask or retort of sufficient capacity, with enough of the strongest fuming hydrochloric acid to drench it completely. The freedom of this acid from arsenic should be first carefully determined. The complete separation of arsenic from organic substances depends greatly on their perfect desiccation, and on the concentration of the acid employed. After some hours' digestion the retort or flask containing the mixture—which should be of such a size that the materials should not fill it to more than one-third or one-half of its capacity—should be fitted with a long condensing tube, and then gradually heated by a sand-bath until the acid liquid begins to pass over; or the use of a Liebig's condenser is preferable. A small flask receiver with a loosely-fitting cork may be employed to collect the product. This should contain a small quantity of distilled water, so as to fix and condense any vapours that may pass over. The receiver, as well as the condensing tube, should be kept cool by wetting its surface with cold water diffused on a layer of bibulous paper placed over it. The perfect condensation of the distilled liquid is ensured by this arrangement. The distillation may be carried to dryness, or nearly so, on a sand-bath; and it is advisable, in order to ensure the separation of the whole of the arsenic as chloride, to add to the residue in the retort another portion of pure and concentrated hydrochloric acid, and again distil to dryness. The author found, however, that portions of dried liver and stomach gave up every trace of arsenic by one distillation, when a sufficient quantity of hydrochloric acid had been used, and the process slowly conducted by a regulated sand-bath heat.

The liquid product may be coloured, turbid, and highly offensive if distilled from decomposed animal matter. Exposure to the air for a few hours sometimes removes the offensiveness, and there is a precipitation of sulphur, or of some sulphide, without any absolute loss of arsenic. The distillate may be separated from any deposit by filtration, and, if still turbid, it may be again distilled at a lower temperature to separate it from any organic matter that may have come over.

If arsenic was present in the solid, the distillate will be a solution of arsenious acid in hydrochloric acid. The quantity of dry organic substance used in the experiment must depend on the quantity of arsenic present, as revealed by a preliminary trial with Reinsch's process. If large, two or three drachms of the dried substance, or even less, will yield sufficient arsenic for further proceedings. For the absorbed and deposited poison, half an ounce of the dried organ, corresponding to two ounces of the soft organ, will frequently suffice; but a negative conclusion of the absence of arsenic should not be drawn from a smaller quantity than two to four ounces of the dried substance, whether liver, kidney, or heart. These tissues, it must be remembered, contain about 67 per cent. of water, so that the hydrochloric acid used will require less dilution. If oily matter should be distilled over, this may be separated by passing the distillate through a paper filter wetted with water.

The author found this process efficient for procuring a clear solution of terchloride of arsenic from such different substances as ordinary food—the liver and other soft organs—the scalp of the head—blood—contents of the stomach—arsenical wall-papers—metallic copper—blue vitriol—and various mineral powders. He thus discovered arsenic in two ounces of the earth of cemeteries, as well as in the mud of rivers, in spite of the presence of much earthy matter. Whenever the arsenic admits of solution in hydrochloric acid, however small the quantity present, it may be readily obtained as chloride. This distillation process has the advantage of not interfering with the search for mercury, lead, copper, and other poisonous metals which do not form volatile chlorides. Arsenic is thus separated from them, and these metals may be found in the residue contained in the flask or retort. Even antimony, which forms a volatile chloride, is not so readily distilled over as arsenic. (On the diffusion of arsenic and the detention of this poison in the bones, see a paper by Sonnenschein, Horn's *Vierteljahrsschrift*, 1870, p. 169. Tidy believed that arsenic was retained in bones for many years.)

The distilled liquid may be at once submitted to a further analysis. For this purpose one-third of it should be diluted with three or four parts of water and boiled in a clean flask. When boiling, a piece of bright copper-foil (free from arsenic), about the sixteenth of an inch square, should be introduced at the end of a platinum wire. If there is arsenic in the liquid, even up to the four-thousandth of a grain, its presence will be indicated by a change of colour, and by the deposit of a dark metallic film on the copper. If the liquid should be too much diluted for this purpose, it may be concentrated on the polished copper, and the deposit will after a time be apparent. If the quantity of arsenic present is believed to be very small, the copper introduced should be proportionately small. Add to a solution of stannous chloride its bulk of fuming hydrochloric acid. Warm this mixture, and then add to it a few drops of the distillate. The presence of arsenic is indicated by a dark-brown precipitate of reduced arsenic.

The remaining two-thirds of the distilled liquid, sufficiently diluted, should now be introduced into a Marsh's apparatus, or into an evolution flask provided with a funnel-tube, the capacity of which must be regulated by the quantity of acid liquid to be examined. The apparatus being made, the zinc and hydrochloric acid are first tested as to their freedom from arsenic. Portions of pure zinc are placed in the flask, the parts of the apparatus are then connected, and pure hydrochloric acid, diluted with three or four parts of water, is poured into the flask by the funnel, which operates as a safety valve. Bubbles of air and gas speedily appear in the liquid, if the corks fit well, and the whole of the arrangements are air-tight. Pure zinc is sometimes but imperfectly acted on by the acid. In this case some clean platinum wire, or foil, may be wound round the bars of the zinc, and the evolution of hydrogen will be thus accelerated. It is, however, better that the hydrogen should come off rather slowly. If the materials are pure, the solution of nitrate of silver should undergo no change of colour. The glass should be placed on a sheet of white paper, whereby the slightest tinge of colour is made perceptible. When all the air is expelled from the tube, flame may be applied to it at about one inch in front of a contraction of the glass, and the glass heated to redness. No metallic deposit should take place if the materials are pure, the transparency of the glass tube remaining unchanged. From a quarter to half an hour will be sufficient for this experiment. A portion or the whole of the distillate is now added to the acid liquid in the flask by means of the funnel-tube, taking care that it is never more than one-third full. The first indication of the presence of arsenic is manifested by the silver solution becoming gradually brown, and finally black, a dense precipitate of metallic silver resulting from the chemical changes. If it should become very suddenly black and flaky, the presence of sulphur may be suspected. This will be further indicated by a change of colour in the lead paper. Pure arseniuretted hydrogen does not alter the colour of this paper. When the silver solution is nearly blackened, the flame may be applied, and kept steadily at one point. At a red heat, visible in daylight (1200° F.), arseniuretted hydrogen is decomposed, and metallic arsenic is deposited; but being a volatile metal, it is carried onward by the hot current of gas, and forms at first a brown and then a black metallic mirror in the contracted part of the tube which is cool. When a sufficiently thick deposit is obtained, the flame may be applied to the tube about an inch in front of the first contraction. Thus as many deposits of metallic arsenic may be procured, as there are contractions in the glass tube.

The silver solution is allowed to become saturated with the gas. Any escape of the gas from the glass, or by leakage from any of the junctions of the apparatus, is at once indicated by holding near to the spot filtering paper moistened with a solution of nitrate of silver. This is instantly blackened. The glass with the silver solution is then removed, the end of the tube well washed, or another tube substituted, and this is allowed to dip into about one drachm of the strongest fuming nitric acid, in a test-glass or into a small porcelain capsule. After a time the acid loses its colour, and the arsenic is converted into arsenic acid, which may be obtained by evaporation.

The further testing of the products is a very simple process. 1. The silver solution contains arsenic in the state of arsenious acid, with some nitric acid and the excess of nitrate of silver. By one or two filtrations it is obtained colourless and clear. A weak solution of ammonia is then added to it, and yellow arsenite of silver is at once precipitated. 2. The nitric acid liquid is evaporated to dryness in a small porcelain capsule. One or two drops of water are added to the residue, with a drop of weak ammonia if it should be very acid. A strong solution of nitrate of silver is then added to it; arsenate of silver, of brick-red colour, is immediately produced. 3. The portions of tube with the metallic deposits in them may be separated by a file, and then hermetically sealed, or, if necessary, one or more of them may be tested by the methods described in the previous pages.

With these results the evidence of the presence of arsenic may be considered as conclusive. The poison is obtained by this process, not only in the metallic state, but in the distinct forms of its two well-known oxides—arsenious and arsenic acid. Reinsch's process is here employed merely as an adjunct to Marsh's process, in an improved form in which the burning of the gas is unnecessary. The arsenic by distillation is first converted into chloride, the chloride into hydride, and the hydride into the respective oxides. In the different stages of this operation all other metals, excepting antimony, are entirely excluded, and this, under the circumstances, may be easily distinguished from arsenic (see "Antimony"). The zinc which has been used for one experiment is not fitted for use in a second.

Reinsch's process alone may be employed for detecting arsenic, deposited as a result of absorption, in the liver, kidneys, or other organs. About four ounces of the recent organ, or more if necessary, cut into very thin slices, should be boiled in a flask in a mixture of one part of pure hydrochloric acid and two of water, until the structure of the organ is broken up. The flask may be of the ordinary shape only with a wide mouth, and either a naked gas or spirit-flame or a sand-bath may be employed. A small glass funnel should be placed in the neck of the flask. This receives and condenses the vapour, which falls back into the flask. By this arrangement the boiling may be continued for a long time, without material loss by evaporation. The flask should not be more than half full and heated gently until all froth is expelled. A slip of fine platinum-wire, having a small piece of pure copper-foil or gauze attached, should be immersed in the liquid when boiling. This enables the operator to remove the copper and examine it at intervals, after immersing it in distilled water. If it is much coated with a metallic deposit, large portions of copper-foil may be successively introduced until the liquid is exhausted. The deposits on the copper may then be tested by the methods described above. This process will detect arsenic in the urine and saliva eliminated from the living body, and in all liquid articles of food.

When hydrochloric acid is diluted with this proportion of water little or no volatile terchloride of arsenic distils over. In reference to the recent organs, a larger proportion of acid is used, because from two-thirds to three-fourths of the weight of the animal substance is water.

The method of Fresenius and Babo is preferable to all others for the destruction of organic matters and the obtaining of arsenic from organic mixtures, the solid organs, etc. The substance to be examined —if a solid, finely shred—is placed in a porcelain dish and treated with a quantity of hydrochloric acid of the sp. gr. 1·12 equal to, or rather exceeding, the weight of the dry substances present, and sufficient water to give the entire mass the consistence of a thin paste. The quantity of hydrochloric acid added should never exceed one-third of the entire liquid present. Heat the dish on a water-bath, adding from time to time—say, every five minutes—two grains of chlorate of potassium for each fluid ounce of liquid in the dish, with stirring, until the contents of the dish are light yellow in colour, homogeneous, and fluid. A further addition of hydrochloric acid may be requisite when much chlorate is added, for the destruction of the organic matters. The operation is completed when the liquid after a fresh addition of either chlorate or acid does not deepen in colour when heated anew on the water-bath for a quarter of an hour. When this point is attained, add again a little chlorate and then cool the dish. When quite cold, strain the contents through linen, filter, wash, and heat the filtrate on the water-bath, with renewal of the evaporated water, until all odour of chlorine, or nearly so, has disappeared. The liquid thus obtained, measuring about thrice the bulk of the hydrochloric acid employed, is transferred to a flask and heated to from 150° to 160° F., and a slow stream of washed sulphuretted hydrogen gas is passed through it for twelve hours. The flask is then cooled, with continual transmission of the gas. The stream of gas is now suspended; and the flask is set aside, lightly covered, in a warm place (85° to 90° F.) until the odour of sulphuretted hydrogen has nearly disappeared. Any precipitate which forms is collected on a filter, and washed with water containing sulphuretted hydrogen till the washings are quite free from chlorides. The precipitate contains the arsenic and also any antimony, mercury, lead, or copper which may be present, and free sulphur. Dry the precipitate on the filter in a dish on the water-bath, and then add pure fuming nitric acid (free from chlorine), drop by drop, until the mass is completely moistened; re-dry, and moisten the dry residue with pure warm concentrated sulphuric acid. Heat for two or three hours, first on the water-bath, and then in the air-bath at 340° F. until the charred mass is friable. The mass may, indeed, be heated till the fumes of sulphuric acid begin to be evolved. Warm the residue with a mixture of eight parts of water and one part of hydrochloric acid, filter, and reprecipitate as before with a stream of sulphuretted hydrogen gas. The precipitate which falls will contain all the arsenic in the form of sulphide. This precipitate collected, washed, and dried with the precautions already pointed out, when mixed with a dry mixture of potassium cyanide and sodium carbonate, and heated in a tube through which a stream of carbonic acid gas is passed, will yield a brown glistening sublimate of metallic arsenic, which may be weighed, and to which all the tests for arsenic may be applied.

With regard to arsenical compounds other than the simple arsenious acid a few words may be said.

Fowler's Solution (or *Liq. Arsenicalis,* B.P.) is a solution of arsenite of potassium. It has the odour of tincture of lavender, is of a reddish colour, and has an alkaline reaction. It contains 1 per cent. of arsenious acid. It gives at once a green precipitate (arsenite of copper) with sulphate of copper, and a yellow precipitate with nitrate of silver. Acidulated with hydrochloric acid, and treated with a current of sulphuretted hydrogen gas, it yields a yellow sulphide; and when boiled with this acid and copper, a deposit is obtained which readily furnishes octahedral crystals of arsenious acid. When boiled with stannous chloride metallic arsenic is deposited as a brown precipitate.

The pigment called emerald green is a mixture of acetate and arsenite of copper. The colour is most intense even by candle-light. The presence of arsenic in this compound may be easily detected by the tests for arsenic; but the following is a simple method, which admits of speedy application. A slip of the suspected paper should be soaked in a moderately strong solution of ammonia. The colour is removed and a blue amide of copper is formed and dissolved in a few minutes. This result establishes only the presence of a compound of copper soluble in ammonia. If the ammonia does not become blue, there is no copper present; if it does become blue, a crystal of nitrate of silver must be placed in a white saucer, and a small portion of the blue liquid poured over it. The presence of arsenic is revealed by the production of yellow arsenite of silver over the surface of the crystal. Another method consists in adding a fragment of the paper to boiling stannous chloride, acidulated with fuming hydrochloric acid. Metallic arsenic is precipitated of a brown colour. A small portion of the paper dissolved in hydrochloric acid added to Marsh's apparatus will set free arsenic in the form of arseniuretted hydrogen.

Arsenic Acid is a white non-crystalline deliquescent solid. (1) It is not entirely volatilised when heated on platinum-foil in the flame of a lamp. (2) It is very soluble in water, forming a highly acid solution. (3) It is precipitated of a brick-red colour by nitrate or ammonio-nitrate of silver. In these characters it differs from arsenious acid. (4) It yields readily an arsenical sublimate when heated with charcoal. (5) It yields deposits by Reinsch's process, but less readily than arsenious acid. Arsenic acid and the arsenates yield a brown deposit of metallic arsenic when added to a boiling solution of stannous chloride. A coarse sort of blotting-paper, soaked in a solution of arsenate of potassium, is extensively sold for killing flies under the name of *papier moure.* It has been erroneously represented that the substance with which it is impregnated is not poisonous to human beings (*Lancet,* 1860, 1, p. 145; also "Ann. d'Hyg.," 1860, 1, 292).

The powdered *sulphide* yields a solution of arsenious acid on boiling it in water acidulated with hydrochloric acid. It readily gives the well-known sublimates of metallic arsenic both with soda-flux and ferrocyanide of potassium. *Organic Mixtures.*—The sulphide being insoluble in water, it is in general easily separated mechanically by allowing the matters mixed with it to become dry upon bibulous paper. If it cannot be separated mechanically, the organic matter suspected to contain it should be dried and evaporated to dryness with strong nitric acid, until it is destroyed. Any arsenic will then be found under the form of arsenic acid, soluble in water.

Cases.—The following is quoted from the *B. M. J.* Epit., p. 21, for August 8th, 1903:—

Methyl disodic arsenate was first introduced into therapeutics by A. Gautier in 1902, and is largely prescribed by French physicians under the name of *arrhénal.* It consists of white crystals having the formula $CH_3AsO_3Na_2H_5O_2$. It is freely soluble in water, sparingly soluble in alcohol, and insoluble in ether. Gautier recommends *arrhénal* in the place of the caccodylates, which are apt to disturb the gastric and intestinal canals. The usual dose for intestinal or subcutaneous administration varies between 0·025 gr. and 0·1 gr. per diem. A. Le Roy des Barres (*Arch. Gén. de Méd.,* June 30th, 1903) places on record a case of acute poisoning by *arrhénal.* A patient, aged forty, was ordered a course of arsenic in the form of *arrhénal* in doses of 0·05 gr. per diem for a fortnight in each month, the cure lasting three months. At the same time Hunyadi Janos water was prescribed as an aperient. By a mistake on the part of the patient's attendant he was given the entire bottle of *arrhénal,* containing 1 gram. Five minutes later vomiting without pain commenced, followed in a few minutes by diarrhœa. Within twenty-four hours the patient vomited twelve times and passed twenty liquid stools. During the second day no vomiting occurred, but five or six diarrhœic stools were passed. No trouble was experienced after the fourth day, and the patient was observed for over a month to remain free from all secondary symptoms of poisoning. This case appears worthy of record for several reasons: first, cases of poisoning by this drug are extremely rare; secondly, they present marked differences from the ordinary cases of acute poisoning by other preparations of arsenic. In doses of 1 gram, vomiting, without hiccough, and diarrhœa only are present. There is an absence of burning acid sensation in the hypogastrium, of acute abdominal spasm, and of headache. The patient is free from loss of heat in the extremities, from muscular cramp, from collapse, and from cardiac syncope. Convalescence is uninterrupted, and the symptoms of reaction, such as fever, tympanites, jaundice, cutaneous eruptions, etc., which often herald a fatal termination in cases of acute arsenical poisoning, are completely absent. The author suggests that the benign course of the case recorded may be due to the exceedingly poisonous dose of the drug absorbed, producing vomiting and diarrhœa immediately; but he points out how different are the symptoms in non-fatal cases of acute poisoning by other arsenical preparations.

For fatal cases of arsenical poisoning by vaginal introduction, *vide B. M. J.,* Epit., 1, 1897, No. 56; also 2, 1899, No. 9. Accidental case of arsenic in vinegar (*vide B. M. J.,* 1, 1898, p. 735), it was given to some forty or fifty soldiers, with acute symptoms. In the *Lancet,* 1, 1901, p. 1199, will be found an account of arsenical poisoning arising from stockings dyed with arsenical pigments, and a reference to cases occurring in 1879.

The following case (*Lancet,* 2, 1896, p. 560) is interesting from the verdict rather than from anything else:—

At a sitting of the High Court of Justiciary held at Inverness on the 11th inst., Ellen Beaton was charged with using arsenic or other poison with intent to murder her master, Mr. Thomas Hay, and a number of other people who were dining with him. It appeared that the woman had declined to prepare dinner when ordered to do so, and Mr. Hay had secured the services of a neighbour. To this the prisoner objected, and though put out of the house, came back after a time and took some part in the preparation of the food. When the broth was served it was observed to have a bitter taste, and after partaking of it the guests one by one were compelled to leave the table, being seized with vomiting. Medical assistance was procured, and ultimately the occurrence was reported to the police. At the trial prisoner was found to have taken part in the preparation of the broth, which by chemical analysis was shown to contain arsenic. The jury, by a majority, found prisoner guilty of administering poison with intent to annoy, but not guilty of any murderous intent, and she was sentenced to fifteen calendar months' hard labour.

In May, 1904, at Kendal, Elizabeth Nicholson and Thomas Metcalf were charged with poisoning James Gilpin by arsenical poisoning between March 17th and 20th, 1904. So far as motive and opportunity (given in gruel to an old bedridden man) and symptoms the case had no features of interest. The poison was openly purchased, and for the defence it was alleged that it had been taken by accident. At the final trial the prisoners were eventually acquitted. In Sir Thos. Stevenson's evidence there was one point of some importance, viz., the fact that the arsenic was coloured with ultramarine. His evidence was as follows: That on April 7th he received three jars from the Chief Constable of Kendal. They were securely fastened and sealed with Dr. Hellon's seal. Two were marked "B" and "C," and the other one he marked "A." The box (produced) containing a portion of a rat-hole was also handed to him. Subsequently he received a packet of arsenic by registered post. He had carefully examined and analysed the articles. "A" jar contained the stomach of an adult person and weighed 8 oz. The mucous membrane showed signs of inflammation, and there were some small hæmorrhages below the mucous membrane. There was no arsenic visible to the naked eye in the stomach. The "B" jar contained portions of the small bowels of an adult, which showed signs of acute inflammation. There were no particles of arsenic or pigment visible to the naked eye. The "C" jar contained three portions of bowel of an adult. The mucous membrane was inflamed. There was no arsenic or pigment visible to the naked eye in these contents. The appearances of the stomach and bowels were those of a person who had died from gastro-enteritis—inflammation of the stomach and intestines. They were in a good condition considering the person had been dead a fortnight, which was suggestive of death from metallic irritant poisoning, not necessarily arsenic, which would act as a preservative. He determined the quantity of arsenic present at 0·689 of a grain. Dr. Hellon's quantities added to these made a total of 0·712 of a grain in the three jars. If the arsenic were taken through the mouth it must have been taken a considerable time before death—he should say many hours. It might have been given a couple of days before death. The effect of vomiting would be to remove arsenic from the stomach and the upper part of the small intestines. The packet produced contained over half an ounce of white arsenic, 83 per cent., coloured blue, with blue pigment of ultramarine. The presence of that particular pigment (the colouring) was very important. If it had been indigo or soot it would not have been affected so far as the colour went by the acid of the stomach. In the case of the arsenic coloured by ultramarine the acid of the stomach destroyed the colour. An ordinary fatal dose for a healthy adult would be 2 grains of white arsenic, or 2½ grains of blue arsenic. He was of opinion that half that dose, or a little more, would kill an old and feeble man. The box containing the rat-hole contained rough plaster and partly burnt coal, weighing 9 oz. The whole of the arsenic in the contents of the box would not amount to 1·60th part of a grain; he could find no trace of arsenic on the surface of the plaster. There was usually a trace of arsenic in plaster and coal, and what trace he did find was of a very insignificant quantity. On April 16th, by the licence of the Home Secretary, he attended Kentmere cemetery for the purpose of exhuming the body of James Gilpin. Most of the body was unusually well preserved considering that it had been buried for twenty-four days. He examined all the chief organs, and did not find any appearance to account for the natural death of the deceased. The heart, lungs, and kidneys were quite competent to perform their functions. There were only the usual appearances of degeneration met with in persons of middle and old age. He removed the following viscera for purposes of analysis: the whole liver (weight 37 oz.), kidneys (9½ oz.), spleen (3½ oz.), the heart and its appendages (19½ oz.), 4 oz. of fluid from the chest cavity, and muscle from the thigh (15½ oz.), also 42 grains of hair from the head. He reserved the heart, spleen, and hair. In all the other organs he found absorbed arsenic to the extent of 0·195 of a grain. This was not a very large quantity, but quite sufficient to show that deceased had received a fatal dose. Taking the quantities given as the basis for the whole body, the quantity absorbed would be from 2 to 3 grains at the least, this being in addition to that in the stomach and intestines. From the quantities he had found, coupled with the symptoms during life and post-mortem after death, he had no doubt Gilpin died from acute poisoning by arsenic. From the evidence it would appear that it was an anonymous letter which led to police inquiries, the medical man who attended deceased having given a certificate of death without suspicion, the victim being described as an octogenarian.

Poisoning by Antimony.

Source and Method of Occurrence.—Antimony shares with arsenic the unenviable *rôle* of being the choice of the wilful poisoner, most of the *causes célèbres* of modern times having to do with one or the other, or both together.

Antimony in the form of tartar emetic is used medicinally in the shape of vinum antimoniale, strength two grains to the ounce (official dose, ten to thirty minims, or two to four drachms as an emetic), and this is the form in which the metal is usually employed for criminal purposes. The chloride or butter of antimony, is also used as "bronzing liquid" for trade purposes, and occasionally cases of accidental poisoning occur from it. In 1891 one death from a salt of antimony was recorded in England, and one suicide in 1901 from the chloride. Dr. Taylor collected thirty-seven cases, of which fifteen were fatal (Guy's Hosp. Rep., 1857).

Tartar emetic as a solid, in the state of powder, is white and crystalline. It has been occasionally sold by mistake for tartaric acid, with soda powders, and sometimes for cream of tartar. Its official dose is one-twenty-fourth to one-eighth grain as a diaphoretic, one to two grains as emetic.

Toxicity and Fatal Dose.—The smallest fatal dose of tartar emetic was in a child **three-quarters of a grain,** and in an adult **two grains**; but in this instance there were circumstances which favoured the fatal operation of the poison (Guy's Hosp. Rep., 1857). Although these very small doses with fatal results are on record, there are marked differences as regards severity of symptoms and fatality with much larger quantities. These differences probably depend in some degree on whether active vomiting and purging have been excited or not, for these symptoms have not been present in all cases. Doses of from twenty grains to one ounce have been taken without destroying life, although alarming symptoms of irritation have followed. In one case, a man, æt. 50, took forty grains of tartar emetic, and died in about four days. This was the only one out of five cases of poisoning by this substance quoted by Orfila which proved fatal (Orfila, vol. 1, p. 480). Beck mentions a case in which fifteen grains of tartar emetic in solution killed a child in a few weeks; vomiting and purging were among the symptoms, and these were followed by convulsions and death. Mr. Bravo also vomited freely, yet he died (see p. 510, *post*). This case proves that a patient is not always saved by vomiting and purging; but it must be remembered that in his case opium very probably shared in causing death. A dose of four grains, however, has been known to produce alarming symptoms.

A man, æt. 28, swallowed *two drachms* of tartar emetic by mistake for Epsom salts, and recovered from its effects.

A boy, æt. 12, swallowed by mistake for ginger-beer four or five drachms of a solution of butter of antimony. In half an hour he was seized with vomiting, which continued at intervals for two hours. Remedial means were adopted, and he recovered in about eight days. Another case of recovery from a dose of an ounce is reported (*Lancet*, Feb. 26th, 1848, p. 230).

These doses may remain as recorded, but the principles on p. 308 *et seq.* must always be borne in mind.

Duration.—In acute cases death may occur within twenty-four hours; but it is more common at a later period. An adult was killed in ten hours by a dose of one drachm, in spite of early and violent vomiting (*Med. Gaz.*, vol. 45, p. 801). In two cases *ten grains* killed each child in a few hours.

In 1881 a young man was killed in **six hours** by a dose of fifteen grains of tartar emetic. The characteristic eruption of tartar emetic was found on the mucous membrane of the stomach (Friedreich's *Blätter f. Gerichtl. Med.*, 1882, p. 8).

In the *Assoc. Med. Jour.* for April 1st, 1853, p. 281, will be found reported a case in which a physician took half an ounce of tartar emetic by mistake for Rochelle salts. Vomiting did not come on for half an hour, but under treatment he recovered in a few days. Couling observed a case of recovery from a large dose in 1866. A veterinary surgeon swallowed, by mistake for carbonate of sodium, about 200 grains of tartar emetic in powder. He noticed a peculiar taste. Vomiting came on in fifteen minutes, but only after tickling his throat. This continued violently. In two hours there was severe purging, with symptoms of collapse. The vomited matters were green, and the evacuations like boiled sago. There was no appearance of blood in either. In three hours severe cramps came on, affecting all the muscles; he was unable to move or speak. Brandy and other remedies were employed, and in six hours, after a warm perspiration, he began to recover. There was suppression of urine; only a small quantity was passed, and this was of a coffee colour. For two or three days he suffered from stiffness in the limbs and in the muscles of the abdomen. In one case, fifty-five grains caused the death of an adult in sixteen hours. In another instance a small dose of this substance caused death by producing intestinal hæmorrhage (*Assoc. Med. Jour.*, June 10th, 1853, p. 513).

Two children, a boy aged five years and a girl aged three years, each swallowed a powder containing *ten grains* of tartar emetic. In twenty minutes after taking the powders, they were seized with violent vomiting and purging, and great prostration of strength, followed by convulsions and tetanic spasms; there was also great thirst. The boy died in eight hours, and the girl in twelve or thirteen hours, after swallowing the dose.

A girl, æt. 16, swallowed a dose of tartar emetic amounting to from forty to sixty grains. There was severe vomiting in a quarter of an hour, and this was soon followed by purging; these symptoms continued for about three hours. She also complained of pain, and a burning sensation, along the gullet. The vomited matters were of a dark colour. On the following morning she had recovered from the severity of the symptoms; but in the afternoon there was a relapse. She continually threw her head back and screamed; the skin was warm and moist; the pupils were dilated, and the knees drawn up. She died in about thirty-six hours after taking the poison, and during the six or eight hours previous to her death she was delirious.

In another case, an army surgeon swallowed, for the purpose of suicide, from two to three fluid ounces of chloride of antimony. About an hour afterwards there was entire prostration of strength, with coldness of skin, and incessant attempts to vomit. The most excruciating griping pains were felt in the abdomen; and there was a frequent desire to evacuate the bowels, but nothing was passed. In the course of a few hours reaction took place, the pain subsided, and the pulse rose to 120. There was now a strong disposition to sleep, so that he appeared as if labouring under the effects of a narcotic poison. In this state he continued until he died, ten hours and a half after he had swallowed the poison.

Symptoms.—When tartar emetic is taken in a poisonous dose, a strong metallic taste is perceived in the mouth during the act of swallowing. In from a few minutes to an hour there is great heat and constriction of the throat, with difficulty of swallowing, violent burning pain in the region of the stomach, followed by incessant vomiting and, later, profuse purging, faintness, and extreme depression. The symptoms are indeed those of acute gastro-intestinal inflammation. The pulse is small, rapid, and sometimes imperceptible; the skin cold, and covered with a clammy perspiration; and the respiration is painful. Should the case prove fatal, death may be preceded by giddiness, insensibility, great prostration of strength, and sometimes violent spasms of the muscles of the extremities, which may assume either a clonic or a tetanic character. Such are the symptoms in an acute case of poisoning by this substance. Cases of poison by tartar emetic at first greatly resemble those of poisoning by arsenic; but in fatal cases the remissions often seen in arsenical poisoning are absent, and recovery is common even when there is great collapse. Occasionally a pustular eruption like that produced by the external application of tartar emetic appears on the skin.

Procter met with the cases of four children to whom, in 1860, by mistake, a mixture of sulphur and tartar emetic had been given. An ounce of sublimed sulphur and one drachm of tartar emetic had been divided among the four. The symptoms presented the same characters in each: early vomiting, which became violent and incessant, pain in the bowels, purging, great thirst, cold clammy perspiration, feeble pulse, cramps of the limbs and twitchings of the muscles, with great depression. There was no sense of heat or constriction in the throat, and no difficulty of swallowing. Under treatment they all recovered.

A man, æt. 28, swallowed two drachms of tartar emetic, and in an hour after the poison had been taken he was found in the following state:—His pulse was imperceptible, the tongue was dry and red, the countenance cold, livid, bathed with clammy perspiration, and indicative of great suffering; violent pain was felt in the stomach and over the whole of the abdomen, with constant spasmodic contraction of the muscles, particularly of the abdomen and arms. The fingers were firmly contracted, and the muscles quite rigid. He vomited once, about half an hour after he had swallowed the poison; and after this he had constant involuntary watery purging. An emetic of mustard and salt was given to him, and this produced violent vomiting of bilious matter. Green tea, brandy, and decoction of oak-bark were freely given. The cramps, vomitings, and watery purging continued for six hours. The symptoms then became mitigated, and he gradually recovered, suffering chiefly from profuse night perspirations (*Lancet*, May 22nd, 1847, p. 535). This case is remarkable for the anomalous character of the symptoms, as, in the absence of active vomiting, an emetic was actually required to be given, and also for the recovery of the individual after so large a dose of the poison.

On April 18th, 1876, Mr. Bravo, a barrister, æt. 30, was poisoned by tartar emetic. After dining with his wife, and whilst alone in a room, at 6.30 p.m., he was suddenly seized with violent sickness and vomiting. When seen at 10.30 p.m. by Moore, he was lying back in a chair totally unconscious; the breathing was noisy, and the heart's action was barely perceptible. He did not seem to suffer pain, and his appearance was not unlike that of a person under the effects of a narcotic. He had previously complained of pain in the stomach, and an emetic of mustard and water had been given. The pupils were widely dilated; and he was unable to swallow when seen shortly afterwards by Harrison. At 1.45 a.m. he first vomited blood. At 3.30 a.m. on the 19th, soon after he was seen by George Johnson and Royes Bell, a little consciousness returned; and he then said, to account for his state, that he had rubbed his gums with laudanum, and that he might have taken some of this liquid. Just before becoming conscious—viz., at 2.45 a.m.—he vomited blood, and passed bloody stools. Throughout the 19th, after the return of consciousness, he suffered excruciating pain, and was violently purged and vomited frequently. On the 20th the patient was seen by Gull, at 6.30 p.m., who found him pulseless and dying. He was told that he was dying of poison, and was asked how he came by it. He replied, "I took it myself." "What did you take?" "Laudanum." When told that he had taken more than laudanum, he made no further statement bearing upon the matter, except to say a second time, "I took it myself." Pain, collapse, vomiting, purging, and occasional convulsions, especially of the upper limbs, continued till near the close, when the vomiting and purging ceased. He died on the 21st of April, fifty-five hours and a half after the commencement of symptoms.

The chloride gives symptoms practically identical, but with more local pain and trouble.

In 1868, a man swallowed three or four ounces of bronzing liquid, which proved to be a solution of chloride of antimony. He vomited violently, but continued his work for an hour; the vomited matters were of a yellowish green colour. There was pain in the stomach, but no purging. He was not seen by a medical man. He had passed a sleepless night, and complained much of oppression in the region of the heart. He died in about eighteen hours.

Four grains gave rise to violent pain in the abdomen, vomiting, and purging. The patient then fell into strong convulsions, which lasted half an hour. He became speechless, no pulse could be perceived, the skin was cold, and it was supposed that he was dead. Stimulating frictions and poultices were employed, and he slowly recovered in about fourteen days.

Chronic Poisoning.—Criminal poisoners rarely resort to one big dose of antimony for their purpose; they more commonly give small doses at intervals.

An account of the effects thus produced by tartar emetic given at intervals in small doses to healthy persons has been published by Mayerhofer ("Heller's Archiv.," 1846, parts 2, 3, 4, pp. 100 *et seq.*). The principal symptoms are those of gastro-intestinal catarrh, viz., nausea and vomiting of mucous and bilious liquids; great depression; watery purging, followed often by constipation of the bowels; small and frequent pulse; loss of voice and muscular strength; coldness of the skin, with clammy perspiration; and death from exhaustion. Several cases have occurred in this country which show that tartar emetic has been thus criminally employed. In addition to the cases of Ann Palmer and J. P. Cook, there are those of *R.* v. *M'Mullen* (Liverpool Sum. Ass., 1856); *R.* v. *Freeman* (Drogheda Spring Ass., 1857); and the cases of the James family at Liverpool (*R.* v. *Winslow*, Liverpool Aut. Ass., 1860). The prisoner Winslow was indicted for the murder of his mistress, Ann James. It was clearly proved that antimony had been administered to the deceased, not only from the symptoms, but by the detection of the poison in the urine during life. The deceased was at the time labouring under malignant disease affecting the cæcum and stomach, but it was alleged that her death had been accelerated by antimony. The prisoner was acquitted, owing to the difficulty of proving the act of administration. The poison had been given at intervals in small doses, and as deceased survived about a fortnight after the last dose, it was found only in traces in the various organs. The death of this woman led to the exhumation of the bodies of three of her relatives who had lived in the same house with her and the prisoner, and had died suddenly some months previously under suspicious circumstances. The viscera of these bodies were examined, and in each case antimony was found in small quantity, but still extensively diffused through the organs. So far as the history of their cases could be obtained, they were victims of chronic poisoning by antimony. This cause of death was not suspected at the time (see Guy's Hosp. Rep., 1857 and 1860; also *R.* v. *Hardman*, Lancaster Sum. Ass., 1857).

This poison, administered in small doses, may occasion death by reason of its exerting a depressing influence on the heart. Aged persons, or those who are debilitated by disease, may die under these circumstances from a medicinal dose or doses which would produce no injury to strong and healthy adults. The effects, however, should be clearly traced to the action of the poison, and not be owing to exhaustion as a result of disease. In 1853, a case was referred to the author in which it was supposed that two doses of antimonial wine, equal to about *three grains* of tartar emetic, had caused the death of a man who was in a diseased condition by its remote effects upon the heart. No trace of poison was found in the stomach or tissues; there were no symptoms to indicate poisoning, and under these circumstances death could not be reasonably attributed to the medicine. The man died in about twenty hours, probably from exhaustion of the vital powers as a result of disease, and not from the action of this substance. This only makes it the more necessary for medical men to be alive to the possibility of crime under such circumstances of ill-health.

The drug is now used very seldom indeed by medical men, compared with the frequency with which it was formerly employed in febrile conditions, so that its presence in a body on analysis is very suspicious.

Treatment.—If vomiting has not occurred, it should be induced by means of an emetic of mustard and water, or by tickling the fauces with a feather, or the stomach-pump or tube may be employed if free vomiting does not occur. In cases of poisoning by "butter or chloride of antimony" the stomach-pump should not be used. After the stomach has been emptied a drachm of tannic acid, dissolved or suspended in warm water, may be administered, with the object of forming an insoluble tannate of antimony. Opium should be given to relieve the pain, and ice may be administered to allay the vomiting and gastric irritation. Demulcent drinks, such as linseed tea, almond mixture, and milk, may be taken, and warmth and stimulants should be employed, if necessary, to overcome the depressing action of the poison.

Post-mortem Appearances.—The preparations of antimony are both irritants, and the chloride is almost a corrosive. Hence possibly corrosion and certainly irritation of the stomach are to be looked for; but it is exceedingly unlikely that the eye will reveal in any special way that it was antimony that was the irritant. In the case of the boy and girl above the bodies were inspected between four and five days after death. In that of the boy there was effusion of serum in the right pleura; the lower lobe of the right lung posteriorly was redder than natural, and the peritoneum was injected from recent inflammation. The mucous membrane of the duodenum was inflamed, and covered with a whitish yellow viscid secretion; this was observed throughout the intestines, although the colour was of a deeper yellow in the large intestines: there was no ulceration. The peritoneal coat of the stomach was inflamed. The mucous membrane of this organ was also much inflamed, especially about the larger curvature and at the cardiac orifice; but there was no ulceration. The contents (about two ounces and a half of a dark bloody fluid having a slightly acid reaction) were adherent to it; and in one case there was a patch of lymph. The tests used did not indicate the presence of antimony. With regard to other appearances, the tongue was covered with a white fur, and appeared sodden; the throat was not inflamed; the windpipe and gullet had a natural appearance. On opening the head the dura mater was found congested; the longitudinal sinus contained a coagulum. The vessels of the surface of the brain were much injected with dark blood, the whole surface having a deep purple colour. Every portion of the brain, when cut, presented many bloody points. The cerebellum and medulla oblongata were also congested: there was no effusion in the ventricles or at the base of the brain. In the body of the girl the morbid appearances were similar; there were in addition on the arms, legs, and neck patches resembling the eruption of scarlatina. The arachnoid membrane was more opaque than usual; and on the mucous membrane of the stomach, where the inflammation was greatest, were two or three white spots, each about the size of a split pea, which appeared to be the commencement of ulceration (*Lancet*, April 25th, 1846, p. 460).

At the autopsy made on Mr. Bravo the day after death the following appearances were observed by Payne. There was no sign of inflammation, congestion, nor ulceration. The stomach contained about eight ounces of thick, gruel-like matter, of a yellowish colour, containing small solid lumps, and had the odour of alcoholic fermentation. The gullet was natural, and contained some of the same matter as the stomach. The first portion of the bowels was very soft, being torn in tying it, but subsequent careful examination showed no perforation nor ulceration. The surface was pale and yellowish, like that of the stomach. The whole of the small intestine was like this, except the lower part, where there were some red spots. This part of the bowels contained yellow pasty matter, without any admixture of blood. Subsequent examination showed, in the cæcum, several small ulcers from which the bleeding had evidently taken place, but there was no perforation. The remainder of the large intestine was very deeply blood-stained, but without ulceration. The contents were soft dark-red material, composed of fæcal matter mixed with blood. The liver and spleen were natural, as were also the pancreas, kidneys, and other abdominal organs. The skull and the membranes of the brain were found quite natural, containing only the usual amount of blood. The brain-substance was also natural, and contained no excessive amount neither of blood nor of watery fluid. The mouth and lips were natural, except that the papillæ at the back of the tongue were somewhat more prominent than is usual. There was no other appearance of disease in the body, except what has been noted.

In the case of the girl æt. 16 (above), an inspection was made thirty-six hours after death. The throat appeared swollen; the lungs were slightly congested; the heart was healthy, and contained about six drachms of fluid blood. The stomach contained sixteen ounces of a thick bloody fluid; at the greater extremity the coats were softened, and blood was effused under the mucous coat in several places. The small intestines contained a similar fluid, with much mucus; but there was no appearance of inflammation. Only slight traces of the poison were found in the contents of the stomach by the usual tests, the greater part having probably passed off by vomiting and purging (*Lancet*, 1854, 1, p. 68). In animals poisoned by this substance, Pavy and the author found general inflammation of the lower half of the intestines.

In a case where the chloride had been used, on inspection the interior of the alimentary canal, from the mouth downwards to the jejunum, presented a black appearance, as if the parts had been charred. In general, there was no mucous membrane remaining, neither on the stomach nor elsewhere; only a flocculent substance, which could be easily scraped off with the back of a scalpel, leaving the sub-mucous tissue and the peritoneal coat. All these parts were so soft that they were easily torn by the fingers. On further inspection, the mucous membrane of the stomach was found much corroded. Near the intestinal end there were numerous putty-like masses. In parts it was of a vividly red colour, and in other parts blackened. There was no perforation. The duodenum presented similar appearances. There was no mark of corrosion on the lips, nor in the lower part of the gullet. The upper part of this tube, the fauces and mouth, could not be examined. Antimony was found in the putty-like masses of membrane as well as in the contents of the stomach and the liquid swallowed.

Analysis.—It must be remembered that the discovery of antimony in the contents of a stomach is by no means a proof of its having been taken or administered as a poison, since tartar emetic is frequently [less so now.—Ed.] prescribed as a medicine, and often taken as such by persons of their own accord. We could only suspect that it existed as a poison, or had caused death, when the quantity present was large and there were corresponding appearances of irritation in the stomach and bowels. The presence of any quantity, if not lawfully administered as a medicine, is always a suspicious fact and demands explanation. In two cases of criminal administration in small doses, the quantity found in each body did not exceed three grains. The mere discovery of it in a medicinal mixture cannot of itself be evidence of an intent to poison.

The detection of antimony in the tissues does not necessarily indicate that it has been criminally administered nor that it has caused death; but its presence should be reasonably accounted for, as antimony may have been unlawfully administered. At the same time it must be remembered that antimony is not a natural constituent of the body, nor are minute traces of it so commonly found in food materials as may be the case with arsenic or copper. In several cases of suspected death from poison, deposits on copper, evidently of an antimonial nature, have been obtained from the liver or tissues. On inquiry it has been found that antimonial medicines had been taken shortly before death. Conversely, when no antimony is found, or the metal is present in the tissues in minute quantity, it is still consistent with medical experience and observation that the person may have died from antimony. The case of Mrs. Peters, of Yeovil (July, 1860), furnishes a remarkable illustration of this fact.

This lady had symptoms during her illness which were referred by her medical attendants to the effects of small doses of antimony. Antimony was found in the urine by them as well as by Herapath; but after death (*i.e.* in about nine days) no antimony was found in the tissues nor any part of the body. Upon this fact, and the evidence of co-existing disease, it was alleged that she had died from disease and not from poison. The jury returned a verdict to the effect that her death had been accelerated by irritant poison (*Med. Times and Gaz.*, 1860, 2, pp. 190, 271, and 317).

The case is important in this respect; it shows that antimony may be found in an evacuation, and that death may be accelerated by the metal; but although the person may die within nine days, none may be detected in the body.

From the first vomit of Mr. Bravo, Redwood obtained antimony equivalent to ten grains of tartar emetic. Antimony was also detected in the liver, and in fluid taken from the large intestines of the deceased, but not in the contents of the stomach. Traces of the metal were also discovered in the urine passed during life. Redwood was of opinion that at least twenty grains of tartar emetic had been taken by the deceased. A verdict of wilful murder by some unknown person was returned, no tartar emetic being traced into the hands of the deceased nor of any other person about him. It was also known that Mr. Bravo was well read in medical jurisprudence, and was acquainted with the poisonous nature of tartar emetic. Some months after the return of the above verdict, evidence came into possession of Sir Thos. Stevenson, who watched the medical aspect of the case at the inquest on behalf of one of the persons living in the same house as deceased, showing that Mr. Bravo had tartar emetic in his possession within six or seven weeks of his decease. He had purchased a large number of quack powders, extensively advertised as a cure for dipsomania, and received instructions that these, if administered too freely to his wife, would cause vomiting. It is possible that these powders —each of them consisting of half a grain of tartar emetic with a pink vegetable pigment—may have been taken in fatal amount by the deceased, who was unaware of their poisonous nature, for the purpose of causing ejection of the laudanum which he had admittedly taken. It is probable that the laudanum would delay the ejection of the tartar emetic, and thus increase the liability to a fatal result.

1. Tartar emetic in the solid state is easily dissolved by fourteen parts of cold, and two of boiling water; the solution has a faint acid reaction, an acrid metallic taste, and is decomposed by long keeping. The salt is insoluble in alcohol. 2. The powder dropped into sulphide of ammonium is turned of a deep orange colour, and is thereby known from other poisonous metallic salts. 3. When heated in a reduction-tube, it is charred, but does not, like acetate of lead, melt before charring. The metal is partially reduced by the carbon of the tartaric acid, and the decomposed mass has a greyish-blue metallic lustre. A metallic sublimate is not produced in this experiment by the moderate heat of a spirit-lamp. 4. When boiled in water containing one-sixth part of pure hydrochloric acid, and metallic copper is immersed in the boiling liquid, a grey deposit of antimony takes place on this metal. The colour of the deposit is violet-red if the quantity is very small, but the deposit is black and pulverulent if very large. 5. The solution acidulated with one-tenth part of hydrochloric acid gives in the cold a black sooty deposit of antimony on a surface of tin-foil. A solution of arsenic produces no deposit on tin under these circumstances. A better method of distinguishing antimony from arsenic, or of detecting arsenic when mixed with antimony, is to employ stannous chloride with fuming hydrochloric acid. Both acids of arsenic, with all their solid compounds, are immediately precipitated on boiling them in this mixture, as brown metallic arsenic, whilst tartar emetic in powder produces no change of colour nor precipitate, unless it contains some traces of arsenic, when the liquid will become brown.

Tartar Emetic in solution.—1. On slowly evaporating a small quantity on a slip of glass it will crystallise in *tetrahedra* and in other derivatives of the regular octahedron. If obtained from a very diluted solution, this crystallisation is confused, and resembles that of arsenious acid. 2. *Dilute nitric acid* added to the solution, throws down a white precipitate, soluble in excess of the acid; the other mineral acids act in the same way; but, as they precipitate numerous other metallic solutions, there are objections to them which do not hold with respect to nitric acid. The white precipitate thus formed is easily and entirely dissolved by a solution of tartaric acid. 3. *Ferrocyanide of potassium* does not precipitate the solution, whereby tartarated antimony is known from most other metallic poisons. 4. *Sulphide of ammonium* and *sulphuretted hydrogen gas* both produce in the solution an orange-coloured precipitate, differing in colour from every other metallic sulphide. The precipitate is not soluble in ammonia, but is dissolved by hot strong hydrochloric acid.

The foregoing tests merely indicate the presence of antimony; but this is in reality the poison which we have to seek. Tartarated antimony is the only soluble salt of antimony which is likely to be met with in medicine or the arts. Should it be required to prove the presence of a tartrate, this may be done by filtering the liquid from which the antimony has been precipitated by sulphuretted hydrogen gas. On evaporating this liquid, cream of tartar may be obtained.

In liquids containing organic matter.—Tartar emetic is precipitated by all forms of tannic acid, but not readily by albumen nor mucous fluids; therefore it may be found partly dissolved in the liquids of the stomach, provided no antidote has been administered. As a trial test, if the liquid is much coloured, a portion of it may be submitted to dialysis; tartar emetic may be thus obtained in water in a state sufficiently pure for testing. The organic liquid should be filtered, and then strongly acidulated with tartaric acid. A current of sulphuretted hydrogen gas is now passed into it, until there is no further precipitation. The sulphide is collected, washed, and dried. If it is sulphide of antimony, it will have an orange-red colour, it will be insoluble in a solution of ammonia, and when dried will be dissolved by boiling hydrochloric acid (forming terchloride of antimony) with the evolution of sulphuretted hydrogen gas. The boiling should be continued for several minutes or until the liquid is colourless. On adding this solution, if not to acid, to water, a white precipitate of oxychloride of antimony (powder of Algaroth, *Mercurius Vitæ*) falls down, soluble in tartaric acid. This is characteristic of antimony. A portion of the acid liquid may be introduced with pure zinc and hydrochloric acid into a Marsh's tube or apparatus. The gas which escapes at the jet produces a black deposit on paper impregnated with a solution of nitrate of silver; but unless sulphur is present it produces no change on paper impregnated with a salt of lead. When ignited, it burns with a pale yellowish-white flame, producing white fumes of sesquioxide of antimony. Porcelain, or glass, depressed on the flame, receives a black deposit of reduced metallic antimony, with greyish-coloured layers of oxide at the circumference. There is no metallic lustre, such as is produced by arsenic, under similar circumstances, but on examining the reverse side of the glass, a dim metallic lustre will be perceptible. This deposit, unlike arsenic, is not dissolved by a solution of bleaching powder If a current of the gas is heated to redness while passing through the tube, a tin-white ring of metallic antimony will be deposited close to the heated spot. This is much more fixed than the deposit of arsenic, and cannot, like it, be resolved into a white sublimate of octahedral crystals. If the gas is made to pass through a small quantity of fuming nitric acid, it is decomposed, the antimony is oxidised, and may be obtained as a white insoluble residue on evaporation. A solution of nitrate of silver produces no change of colour in this deposit; but if one or two drops of ammonia are added, there is a black precipitate of antimonide of silver.

The following method of detecting antimony, when dissolved in any organic liquid, is based upon electrolysis, by which copper and other metals may be detected under similar circumstances. Acidulate a portion of the suspected liquid with hydrochloric acid, and place it in a shallow platinum capsule. Touch the platinum, through the acid liquid, with a piece of zinc. Wherever the metals come in contact, metallic antimony, in the state of a black powder, is deposited on the surface of the platinum. The liquid should be poured off, and the capsule thoroughly washed with distilled water. This may be effected without disturbing the deposit. A small quantity of sulphide of ammonium poured on the black deposit, speedily dissolves it when heated, and on evaporation an orange-red sulphide of antimony remains. This may be dissolved by a few drops of strong hydrochloric acid, and on adding the acid liquid to water, an oxychloride of the metal is precipitated. By this process antimony in small quantity may be detected in any liquid containing organic matter. In place of sulphide of ammonium, strong nitric acid, or a solution of permanganate of potassium, may be employed to oxidise the metallic deposit and the dry residue treated as described below.

In the tissues.—The antimony may be deposited in the organs, in such manner that neither the sulphuretted hydrogen nor the electrolytic process will yield any satisfactory results. The liver or other organ should be finely cut up, and boiled in a mixture of one part of hydrochloric acid and five parts of water. After some time the liquid may be tested by introducing into it a slip of polished copper-foil free from antimony. If antimony is present in small quantity, the copper will acquire a reddish or violet-coloured deposit on its surface; if in large quantity, the deposit will be grey with a metallic lustre, or sometimes in the state of a black powder. The deposit may be removed from the copper by boiling with a dilute solution of permanganate of potassium, and the solution thus obtained may be tested for antimony. These deposits do not yield octahedral crystals like those obtained from arsenic. A slip of tin-foil may be suspended in the cold, in another portion of the acid liquid, diluted so that the hydrochloric acid forms only one-tenth part by measure. Either immediately, or in the course of a few hours, if antimony is present, the tin is covered with a black deposit of metallic antimony. As arsenic is not deposited on pure tin under similar circumstances, this furnishes a ready method of detecting the admixture of antimony with arsenic. These may be regarded as trial tests. For the demonstration of the presence of antimony, when in mere traces, we may resort to the following process, by which antimony may be completely separated from organic substances. Coil a portion of zinc-foil round a portion of platinum-foil, and introduce the two metals into the hydrochloric acid decoction of the tissues, just sufficiently diluted to prevent too violent an action on the zinc. Warm the organic liquid, and suspend the coils in it. Sooner or later, according to the quantity of antimony present, the platinum will be coated with an adhering black powder of metallic antimony. Wash the platinum-foil and digest it in strong nitric acid. So soon as the black deposit of antimony is dissolved from its surface, the platinum may be removed. Add a few drops of nitric acid, and evaporate the acid liquid to dryness. The residue, redissolved in hydrochloric acid, and the solution diluted and treated with a current of sulphuretted hydrogen, will yield the orange-red sulphide of antimony. This black deposit of antimony is also readily dissolved from platinum-foil by sulphide of ammonium, yielding on evaporation orange-red sulphide of antimony, soluble in hot, strong hydrochloric acid. When kept for a few days in contact with water and air, the black metallic deposit is sometimes converted into a white oxide, and entirely disappears. Antimony in the metallic state is so easily procured from a small quantity of material, by one or other of the above-mentioned processes, that on no account should they be omitted. The procuring of the metal may be made subsidiary to the procuring of the sulphide, as the metal can be easily oxidised and converted into sulphide in a pure form, and obtained entirely free from organic matter. A reliance on a small quantity of a coloured precipitate by sulphuretted hydrogen alone, would be most unsatisfactory as chemical evidence.

It is in all cases best, however, to destroy the organic matter previous to testing for antimony. This may be done, as described under "Arsenic" (p. 498), by means of chlorate of potassium; or the organic matter—liquid or solid—may be heated with sulphuric acid, and successive additions of nitrate of potassium made till a clear and almost colourless solution is obtained. This may then be gently heated till the white fumes of sulphuric acid almost cease to be evolved. The residue, when diluted with water, may be examined by the above tests.

So far as the chloride alone is concerned,—1. If any portion of the chloride is left in the vessel, it may be tested by adding a few drops to a large quantity of water, when the whitish-yellow oxychloride will be precipitated: the supernatant liquid will contain hydrochloric acid, which may be detected by nitrate of silver. 2. The precipitated white oxychloride is dissolved by a solution of tartaric acid. 3. This acid solution is precipitated of an orange-red colour by a current of sulphuretted hydrogen gas.

Cases.—An extraordinary trial for murder by alleged poisoning with this substance took place at Annapolis, U.S., in 1871. Mrs. Wharton was charged with poisoning her friend General Ketchum. The General died after a short illness, but the symptoms, taken as a whole, bore no resemblance to those observed in poisoning with antimony, although poisoning was suspected during life. The appearances in the body proved nothing for or against antimonial poisoning, and some physicians of experience deposed that the symptoms and appearances were consistent with disease affecting the membranes of the brain and spinal marrow. On examining the chemical evidence, it appears that sulphide of ammonium alone was employed for the detection of antimony, and a red-brown sulphide resembling that of antimony was obtained; but the quantity obtained as sulphide was only four-tenths of a grain, estimated as equivalent to *eight-tenths of a grain* of tartar emetic. Thus the chemical analysis brought out only a fraction of a grain, not amounting to one-twentieth part of the quantity said to be present; and no separation of antimony in the metallic state was made to corroborate the inference drawn from the coloured precipitate produced by sulphuretted hydrogen. No chemical results were produced in court, although twenty grains would have allowed of the production of metallic antimony in a few minutes by copper, tin, zinc, and platinum, or by Marsh's process. The evidence that antimony was really there was not satisfactory, and that twenty grains were present in the stomach was wholly unproved. The chemical evidence does not therefore conflict with the pathological evidence, for it failed to show with clearness and distinctness the presence and proportion of the poison said to have been found. The prisoner was acquitted (*Amer. Jour. Med. Sc.*, April, 1872, p. 329).

R. v. *Matchett*, Armagh Assizes, March, 1904, it was stated that the tartar emetic was bought for dosing cattle. Luckily for the victim, the poison was put into the cup in such an excessive quantity that when taken it had the effect of causing him to become violently ill and vomit. The man managed with assistance to get away to the house of another brother, and was there put to bed. He was in a critical condition, and was attended by a doctor for some time. He recovered, and gave evidence that the tea was bitter to the taste, and when his sister-in-law's attention was withdrawn he threw the remains of it away. He was subsequently taken violently ill, being sick and vomiting (*vide* also *R.* v. *Klosowsky*, p. 356, *ante*).

Two women, mother and daughter, were tried (*R.* v. *Wallis and Wallis*, Worcester Sum. Ass., 1883) for the murder of the illegitimate infant of the younger prisoner by means of terchloride of antimony, but acquitted, there being no sufficient evidence of administration. It was at first supposed that the child had died from poisoning by a solution of perchloride of iron, which was detected in the stomach by a medical man. Sir Thos. Stevenson found antimony in the viscera, and also in the matters vomited and passed from the bowels of the child. The perchloride of iron was merely an impurity always present in commercial liquid butter of antimony.

POISONING BY BISMUTH SALTS.

Source and Method of Occurrence.—The carbonate and the subnitrate of bismuth are used in medicine, as also the oxide and the salicylate, all in doses from five to twenty grains.

It has been found that bismuth salts are very opaque to the X-rays, and consequently thickish mucilaginous emulsions of a salt of bismuth are used and swallowed in very large doses, certainly well over an ounce, in order to examine patients on a screen for certain affections of gullet, stomach, and intestine, and also to determine certain points in the process of digestion. Although used in such large doses, no case of poisonous results ensuing has come to the editor's knowledge in recent years, and he is strongly of opinion that the bismuth salts—at any rate the carbonate; the subnitrate may be more risky—are quite innocuous in any ordinary dose. Nevertheless, he leaves the two cases below as they appeared in former editions, as he does not feel justified in omitting them, although strongly supporting Dr. Taylor's opinion as to the probable, nay, almost certain, explanation that the symptoms were due to arsenic, with which metal bismuth was formerly very commonly contaminated.

As bearing very closely on the above remarks we quote the following from the *Lancet*, vol. 1, 1909, p. 257 :—

Bismuth Subnitrate Poisoning.—Until recently bismuth has been regarded as non-toxic, and the few recorded cases of poisoning after its use have been ascribed to the presence of arsenic or other impurity. But it has now been shown that pure bismuth has toxic properties, and its recent administration for purposes of radiography has brought this fact more into evidence. In the *New York Medical Journal* of January 2nd Dr. Emil G. Beck has published an exhaustive paper on the subject. As long ago as 1793 cases of poisoning by bismuth subnitrate were recorded, but were thought to be due to impurities. The first authentic report of bismuth poisoning was published by Theodor Kocher in 1882. He observed that insoluble preparations of bismuth when applied to large wound surfaces may be absorbed to such an extent as to produce characteristic symptoms—acute stomatitis and black discoloration, usually beginning on the gums at the border of the teeth and spreading over the whole mouth, which are followed by intestinal catarrh, pain, and diarrhœa, and in severe cases by desquamative nephritis (Volkmann's *Klinische Vorträge*, 1882, p. 224). Similar cases were reported by Professor Petersen (*Deutsche Medizinische Wochenschrift*, June 20th, 1883). Then literature was silent on the subject until 1901, when Professor Muhlig reported two cases of poisoning after the dressing of burns with bismuth subnitrate. Later two cases of poisoning were reported in America after administration of 60 and 120 grammes respectively of the subnitrate in one dose. The first fatal case was reported by Bennecke and Hoffman (*Münchener Medizinische Wochenschrift*, 1906, No. 19). An emaciated child, aged three weeks, suffered from enteritis. A mixture of three grammes of bismuth subnitrate in 100 cubic centimetres of buttermilk was given in order to diagnose pyloric stenosis by radiography. Twelve hours later cyanosis developed and was followed by collapse and death. After death methæmoglobin and small quantities of bismuth were found in the liver and blood. In the same clinic another fatal case with similar symptoms occurred in a child. Professor Hofter suggested that the symptoms might be due to nitrite poisoning. The blood and pericardial fluid were tested for nitrates, which were detected in both. Then Böhme proved by experiments that the fæces of children in contact with bismuth subnitrate liberate nitrites. He injected this mixture into a ligated loop of a rabbit's intestine and found nitrates and nitrites in the urine, but not in the blood. Routonberg has reported a case in which methæmoglobinæmia and the other symptoms of nitrite poisoning followed the rectal injection of 50 grammes of bismuth subnitrate in 400 cubic centimetres of oil of sesame (*Berliner Klinische Wochenschrift*, 1906, No. 43, p. 1397). These and other cases show that toxic effects from bismuth subnitrate may be due to absorption not of bismuth, but of nitrates. The liberation of nitrites appears to be due to the action of bacteria in the alimentary canal, especially in the sigmoid flexure and rectum. During the past two years Dr. Beck has treated sinuses extensively by injection of a paste containing 33 per cent. of bismuth subnitrate incorporated in petrolatum (*Lancet*, May 9th, 1908, p. 1359). If the bismuth was not discharged soon after injection he proved by a series of radiograms that it underwent absorption. In no case did he observe symptoms of nitrite poisoning, but in many cases he noticed slight lividity of the skin, of the mucous membranes, and a bluish border on the gums. In one case he observed ulceration of the mouth, which has been described by Kocher as characteristic of bismuth poisoning. In another case he injected 720 grammes of the paste into a pleural cavity from which an empyema had been evacuated. The paste was retained for six weeks, and then desquamative nephritis and a blue border around the teeth developed. The bismuth paste was withdrawn by injecting olive oil and applying a specially devised suction pump, and all the symptoms disappeared. Recently Dr. H. Eggenbergel has reported a fatal case of bismuth intoxication following injection of the sinsus of a psoas abscess in a child, aged seven years (*Centralblatt für Chirurgie*, October 31st, 1908), from the clinic of Professor Wilms, of Basle. Thirty grammes of the paste were injected and retained for six weeks. Stomatitis resembling that due to mercury developed, the pulse rose to 130, and cerebral symptoms like those of uræmia followed. The abscess cavity was evacuated, but death occurred a few days later. It thus appears that two forms of poisoning may be produced by bismuth subnitrate—an acute form due to nitrite poisoning and a more chronic form due to bismuth poisoning.

Toxicity and Fatal Dose, Symptoms, and Post-mortem Appearances must all remain very problematical in view of what is written above.

Treatment.—If such a possible case occur, obviously the only treatment is that applicable to irritants in general.

Analysis.—The subnitrate is a whitish, chalky-looking, non-crystalline powder, insoluble in water, soluble in hydrochloric acid, and again precipitated white by dilution with water; the white precipitate is insoluble in tartaric acid, and is blackened by a solution of sulphuretted hydrogen, or by sulphide of ammonium. A solution of the substance in nitric acid gives no precipitate with diluted sulphuric acid.

Arsenic may be detected by dissolving the subnitrate in slightly diluted hydrochloric acid and introducing it into Marsh's apparatus. The arsenical flame is apparent on combustion, and the usual deposits may be obtained on glass and porcelain. The products of combustion may be collected and tested by the processes described for arsenic. This impurity in the subnitrate may modify a conclusion respecting the presence of traces of arsenic in a body when bismuth has been administered medicinally (*Brit. and For. Med.-Chir. Rev.*, October, 1858).

Cases.—*Of Bismuth—Pearl White—Magistery of Bismuth.*—This substance, in a dose of 120 *grains*, caused the death of an adult in nine days. There was a strong metallic taste in the mouth, burning pain in the throat, with vomiting and purging, coldness of the surface, and spasms of the arms and legs. On inspection, the throat, windpipe, and gullet were found inflamed; and there was inflammatory redness in the stomach and throughout the intestinal canal ("Sobernheim," p. 335). In a case mentioned by Traill, a man took by mistake *six drachms* of the subnitrate in divided doses in three days. He suffered from vomiting and pain in the abdomen and throat ("Outlines," p. 115). These cases are sufficient to prove that a substance which is but slightly soluble in water may exert a powerfully poisonous action. The oxide and subnitrate of bismuth, owing to imperfect washing, are sometimes contaminated with arsenic in the form of arsenic acid; and as the symptoms produced by large doses have closely resembled those caused by arsenic, the symptoms may have been due to this impurity.

POISONING BY IRON SALTS.

Source and Method of Occurrence.—Iron salts are amongst the most valuable drugs in the pharmacopœia, and there are very many pharmacopœial preparations of them. The sulphate and the perchloride are the two which form the basis of most of these preparations, and it is from these two salts that cases of poisoning arise. One case is tabled by the Registrar-General in 1901.

Ferrous Sulphate, or Sulphate of Iron—Copperas, or Green Vitriol.—This compound has been several times administered with malicious intention. One death from it took place in 1837–8, and another in 1869 was the subject of a criminal trial in France. A man was convicted of having killed his wife and his son by administering to them ferrous sulphate in coffee (Bouchardet, "Ann. de Thérap.," 1872, p. 146).

Green vitriol or copperas is sometimes given as an abortive, and in this connection the tincture of the perchloride is advertised largely under the name of steel drops.

A suspicious case is reported in which a woman far advanced in pregnancy, but enjoying good health, was suddenly seized at midnight with vomiting and purging, and died in about fourteen hours. The body, which had been buried, was disinterred, and iron found in large quantities in the viscera (*vide* also "Abortion," p. 167).

Copperas is said to have proved fatal to sheep. It had been mixed with the pulp of beet-root for cattle food (*Med. Times and Gaz.*, 1863, 1, p. 511).

Ferric Chloride—Solution and Tincture of Perchloride of Iron.—There are three recognised pharmaceutical preparations of this substance. The stronger liquor of perchloride of iron of the British Pharmacopœia contains about 160 grains of ferric chloride in each fluid ounce. The liquor and the tincture respectively of perchloride of iron are of equal strength—one-fourth that of the stronger solution—and contain each forty grains of the chloride in a fluid ounce, their official doses are five to fifteen minims.

The perchloride of iron has been used as an injection in uterine diseases; but it is a most powerful local irritant, and in one instance caused death by inducing peritonitis. The mucous membrane of the uterus was stained of a deep black colour, and iron was readily detected in its substance (*Amer. Jour. Med. Sci.*, April, 1870, p. 566).

A case was reported to the Westminster Medical Society, in 1842, in which a girl, æt. 15, five months advanced in pregnancy, swallowed *an ounce* of the tincture of perchloride of iron in four doses in one day, for the purpose of inducing abortion. Great irritation of the whole urinary system followed; but this was speedily removed: and she recovered.

At the Lincoln Lent Ass., 1863 (*R.* v. *Rumble*), a druggist was convicted of having supplied this noxious liquid to a woman with the intent to procure her miscarriage. He directed her to take a teaspoonful three times a day, and at the same time prescribed for her eight pills a day, each containing half a grain of powdered cantharides. Although the woman had taken only two doses of the tincture of perchloride of iron, she suffered from severe pain over the whole of the abdomen, with violent pain in the region of the stomach and bladder; there was constant vomiting of a greenish-coloured matter, and great pain in passing her urine. The quantity of urine secreted was small, and contained much blood. These symptoms were in great part due to the cantharides.

It is commonly asserted that pregnant women are affected injuriously by comparatively small doses, but there seems to be no evidence that they are so by any dose between the pharmacopœial limits, which were largely exceeded in the above case. The editor was once asked to say that fifteen drops was an improper dose for a pregnant woman, but such a suggestion is ridiculous.

Toxicity and Fatal Dose.—The toxicity of iron salts is undoubtedly very slight indeed. A girl swallowed an ounce of the sulphate and recovered, in fact, it is difficult to find a fatal case.

Christison relates an instance in which a man by mistake swallowed *an ounce and a half* of the tincture of the perchloride; the symptoms were somewhat like those produced by hydrochloric acid. He at first rallied, but died in about five weeks. The stomach was found inflamed and thickened towards the intestinal end. In another case, a healthy married woman swallowed, by mistake for an aperient draught, *one ounce and a half* of the tincture of perchloride of iron. She immediately ejected a portion, and violent retching came on, which continued for some time. There was great swelling of the glottis, with cough, and difficulty of swallowing. These symptoms were followed by heat and dryness of the throat, with a pricking sensation along the course of the gullet and stomach; and in the afternoon a quantity of dark liquid blood was vomited. The motions were black, owing doubtless to the combination of sulphur with the metal. In about a month the patient was perfectly restored to health (*Prov. Jour.*, April 7th and 21st, 1847, p. 180). Another case of recovery from a large dose has been reported. The patient, æt. 72, swallowed by mistake *three ounces* of the tincture in a concentrated state. The tongue soon became swollen; a ropy mucus flowed from the mouth and nose; there was croupy respiration, and a sense of impending suffocation. The pulse was feeble, the skin cold and clammy, and the face swollen and livid. A castor-oil mixture brought away inky evacuations, and the patient rapidly recovered (*Dub. Med. Press*, February 21st, 1849). From the occurrence of these cases of recovery, it would be a mistake to infer that this is not a noxious compound within the meaning of the Poisons Act and also within the meaning of the Act dealing with abortion (*vide* p. 141). The largeness of the dose has commonly led to early vomiting, and the rejection of the greater part of the acid liquid. Besides, it varies much in strength, and unless this is defined in any given case it is difficult to draw an inference of the actual quantity of perchloride of iron taken.

Symptoms.—Pain in the stomach, vomiting, and purging are likely to be found in an acute case.

In 1879, a teaspoonful of the stronger pharmacopœial solution of perchloride of iron was given, undiluted, to a girl, æt. 18, by mistake for a linctus. The bowels were freely opened, and she vomited several times within ten minutes of taking the liquid. The stomach was then washed out. Shortly after she again passed a stool, and continued to vomit freely. The nurse and patient both asserted that vomiting and purging supervened within three minutes of the administration of the poison. Great feebleness and depression came on. In two days she began to recover; but pain in the gullet continued for several days (unreported case of Sir Thos. Stevenson).

A case of recovery from an ounce of this tincture is reported (*Pharm. Jour.*, April, 1869, p. 605). A woman, æt. 30, swallowed this quantity. She suffered from vomiting and purging, the motions being black. Emetics were given, and she recovered in five days (*Lancet*, 1, 1869, p. 9).

Treatment.—But little is required beyond the general measures on pp. 334 *et seq.* Bicarbonate of soda might be useful to form a less soluble iron salt.

Post-mortem Appearances.—If any, will be those of gastro-enteric irritation.

Analysis.—The hydrochloric acid of the perchloride may be detected by nitrate of silver and nitric acid, while the iron is immediately indicated by a precipitate of Prussian blue on adding a solution of *ferrocyanide of potassium*. If it be the sulphate that is being tested, the precipitate, on adding potassium ferrocyanide, is at first nearly white, but changes to a light blue. As iron is a natural constituent of the body, it is obviously useless to discover mere traces of the metal in the viscera.

Cases.—At the Nottingham Autumn Ass., 1859, a woman named Riley was indicted for administering copperas to two children. She put the substance into gruel. It gave to the gruel a greenish colour and a peculiar taste which led to the discovery. It caused sickness, but no other serious symptoms. As there was no evidence of an intent to murder, and it was then not unlawful to administer poison with any other intent, the prisoner was acquitted.

Poisoning by Osmium.

Osmium tetroxide, commonly known as osmic acid, is a highly poisonous substance, and accidents have occasionally resulted from its use in scientific investigations. It is a transparent, glistening, crystalline body, melting like wax in the hand, beginning to sublime at a moderate heat, and boiling at 212° F. It does not redden litmus, and has a caustic, burning taste. Its odour is most penetrating, and somewhat like that of chlorine or of iodine. The vapour, even in minute quantities, causes serious inflammation of the lungs when inhaled. It also attacks the eyes, so that the experiment of volatilising osmium in the blowpipe is an operation attended with great danger. Deville, who performed the operation twice, was rendered almost blind for twenty-four hours by having become exposed accidentally to the vapour of the tetroxide. This substance produces violent pain and inflammation of the conjunctivæ; and vision may be permanently injured by the subsequent reduction of a film of metallic osmium. The tetroxide also acts violently on the skin, causing painful eruptions.

Poisoning by Chromium.

Source and Method of Occurrence.—Chromium, in the shape of bichromate of potassium, is manufactured in very large quantities for use in the arts; for all that, cases of poisoning by it are not common.

Battery solutions, consisting of a mixture of the bichromate and sulphuric acid, are practically solutions of chromic acid. In 1892, a man committed suicide by swallowing a battery fluid of this nature.

In 1891, two deaths from bichromate of potassium were registered in England and Wales. In 1901, two accidental deaths from bichromate were registered.

Chromate of Lead (chrome yellow) is a powerful irritant poison: a dose of a few grains of this pigment has proved fatal (see case of two boys, "N. Syd. Soc. Bien. Retrospect," 1873-4, p. 452).

Toxicity and Fatal Dose.—A medical man, who had inadvertently tasted a solution of bichromate of potassium, suffered from severe symptoms resembling those of Asiatic cholera (*Prov. Jour.*, December 24th, 1851, p. 700). Wood furnished the author with the particulars of a case in which two drachms of this substance destroyed the life of a woman in *four hours*.

Symptoms.—Bichromate usually acts as a powerful irritant. In the first two hours a woman suffered from violent vomiting and purging, the vomited matters being of a yellow colour. When admitted she was in a dying state, pulseless, unconscious, and breathing slowly with great effort. The skin was cold, the lower lip swollen and purple, and the tongue swollen. Occasionally these irritant symptoms are not present, and the drug acts by its evil effects on the nervous system after absorption (*vide* cases below).

This salt, in the state of fine powder or in a saturated solution, has also a local irritant action on the skin and on parts from which the skin has been removed ("Ann. d'Hyg.," 1864, 1, 83). It produces what are called "chromic sores," affecting the hands and exposed parts of the face. According to recent observations, workers in chrome factories—

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of which there are very few in the world—suffer from a peculiar irritation of the septum of the nose, apparently due to the action of bichromate of potassium, which leads to a perforation of the nasal septum (*Lancet*, 1882, 1, p. 169). This fact has led the executive to include work in bichromate factories as coming within the protective clauses of the Workmen's Compensation Act (*vide* Vol. I.). Chromic acid is a powerful corrosive poison, destroying all organic textures (*Pharm. Jour.*, January, 1872, p. 568).

Treatment.—Must be on general principles (*vide* pp. 334 *et seq.*); there is no specific antidote.

Post-mortem Appearances.—In the case mentioned above the chief appearances were, a dark and liquid state of the blood; the mucous membrane of the stomach was in great part destroyed, of a dark brown colour approaching to purple; the duodenum at its upper part of a florid red colour, and at its lower part much corrugated, as well as the upper half of the jejunum.

Analysis.—Bichromate of potassium may be recognised by its orange-red colour, as well as by the intense yellow colour which it gives to water when dissolved. Its solution gives a deep red precipitate with nitrate of silver, a pale yellow with nitrate of barium, and a bright yellow with salts of lead.

If a dilute solution of potassium bichromate be acidified with hydrochloric acid, and sulphurous acid then added, a green colour is produced, due to the formation of chromium chloride. A similar effect is produced by substituting alcohol for sulphurous acid, and subsequently warming the mixture (Luff).

Cases.—A man, æt. 64, was found dead in his bed twelve hours after he had gone to rest; he had been heard to snore loudly during the night, but this had occasioned no alarm to his relatives. When discovered he was lying on his left side, his lower limbs being a little drawn up to his body; his countenance was pale, placid, and composed; the eyes and mouth closed; the pupils dilated; no discharge from any of the outlets of the body; no marks of vomiting or purging, nor any stain upon his hands or person, nor upon the bed-linen or furniture. The surface was moderately warm. Some dye-stuff, in the form of a black powder, was found in his pocket. On inspection, the brain and its membranes were healthy and natural; there was neither congestion nor effusion in any part. The thoracic viscera were healthy, as well as those of the abdomen, with the exception of the liver, which contained several hydatids. A pint of a turbid, inky-looking fluid was found in the stomach. The mucous membrane was red and vascular, particularly at the union of the greater end with the gullet: this was ascribed to the known intemperate habits of the deceased. In the absence of any obvious cause for death, poison was suspected; and on analysing the contents of the stomach, they were found to contain bichromate of potassium. The dye-powder taken from the man's pocket consisted of this salt mixed with cream of tartar and sand. It is remarkable that in this case there was neither vomiting nor purging. The salt does not appear to have operated so much by its irritant properties, as by its effects on the nervous system. [It seems doubtful whether death was actually due to the chrome salt. May not alcohol have had a share in it?—Ed.] This, however, is by no means an unusual occurrence, even with irritants far more powerful than bichromate of potassium (*Med. Gaz.*, vol. 33, p. 734).

A boy recovered from the effects of a dose of bichromate of potassium, but only after a lapse of four months. The first symptoms were pain, vomiting, dilated and fixed pupils, cramps in the legs, and insensibility. His recovery was due to early and active treatment (Guy's Hosp. Rep., 1850, p. 216). Another case, in which, owing to timely treatment, a man, æt. 37, recovered from a large dose of the salt, was communicated to the author. It seems that with suicidal intent the man swallowed about two ounces of the bichromate in solution, mixed with pearlash. In about two hours he was seen by Andrews, and he was then apparently in a dying state. He was suffering chiefly from severe cramps, the pupils were dilated, the pulse was scarcely perceptible, and there was vomiting and purging of greenish-coloured evacuations. The stomach-pump was used, and olive oil and diluents were given. In about nine hours the urgent symptoms abated, and the man complained only of great pain in the shoulders and legs. There was no gastric irritation nor tenderness of the abdomen. He was discharged cured at the end of a week.

A fatal case occurred at Liverpool in which a woman, æt. 21, obtained and swallowed as a cure for neuralgia a quarter of an ounce of bichromate of potassium. She took it on the advice of an ignorant person who had written the name of the drug on paper as "Bichromide," and the chemist dispensed bichromate instead of bromide, which was the original intention of the adviser. The husband mixed the quantity advised by his brother-in-law, and gave it to his wife, without reading the label. He first tasted it and found it very bitter, but the deceased said "Never mind if it will cure me," and drank it eagerly. She at once complained of sickness and burning, and commenced to vomit. The doctor was called in, and on his advice the woman was removed by her husband in a cab to the Stanley Hospital, where she expired at six o'clock the following evening. Verdict of coroner's jury, misadventure.

In the *Pharm. Jour.*, December 19th, 1896, p. 542, is an account of an inquest held on a woman, æt. 29, who took "a spoonful" out of "twopennyworth" of the salt. A few minutes later she complained of violent pains in the stomach, and commenced vomiting. Her husband prepared an emetic of mustard and water, but she refused to take it. The salt was taken about 10 p.m., and the woman died about 4 p.m. next day. Dr. Howie found her suffering from great collapse twelve hours after the dose was taken. She was livid, and her pulse was rapidly failing. At the inquest Dr. Howie said, she died from "asphyxia and paralysis of the brain centres." Verdict, misadventure.

A case of suicidal poisoning by chromic acid is reported in the *Pharm. Jour.*, March 17th, 1894, p. 791. The acid was kept to supply a battery.

In the *Trans. of the Med. Leg. Soc.* for 1909–10 Dr. Willcox reports an interesting case of poisoning by bichromate of potassium. The symptoms were not observed. There were no gross naked eye changes in the viscera except slight brown discolouration of the wall of the stomach, which Dr. Willcox admitted might have been taken for post-mortem changes. Chromium was found in all organs on analysis, which was made because no cause for death was found on ordinary examination.

POISONING BY NICKEL AND COBALT.

Poisoning by these metals must be extremely rare. The editor inserts the following from the *Lancet*, 1, 1903, p. 268:—

Two workmen employed at the Mond nickel works at Clydach, near Swansea, died from what appeared to be the effects of poisoning by some obscure substance given off during the processes on which they were engaged. Both men were ill for several days before their death, and their symptoms were similar to those exhibited by other men who had been attacked in the previous months but who had recovered. The most prominent features in all the cases were headache, giddiness, high fever, and rapid breathing. Post-mortem examination in the two fatal cases revealed a fatty and in one instance a dilated heart. The Mond Nickel Company was very anxious to ascertain the cause of these fatalities, and Dr. F. W. Tunnicliffe, of King's College, London, and Mr. H. G. Plimmer, of St. Mary's Hospital, were accordingly associated with Dr. John Jones, the surgeon to the works, in making a full investigation. These gentlemen were later assisted by Dr. J. F. Payne, Dr. F. W. Mott, and Dr. Otto Hehner. The conclusions which were arrived at, and which were given to a coroner's jury on January 13th, by Dr. Tunnicliffe, were that "death was caused by nickel carbonyl, a substance inhaled from the dust given off during employment, which, although the immediate symptoms of it were transient, caused after a short time degeneration of certain parts of the nervous system," and that "this substance also in all probability produced a change in the condition of the blood." Further investigations are being made with regard to the scientific aspect of the question.

The result of these was that poisoning by this compound was included amongst the occupation diseases in the Workmen's Compensation Act (*vide* Vol. I.). We take the following article from the *Lancet*, vol. 1, 1909, p. 487:—

Poisonous Metallic Carbonyls.—A further contribution on the poisonous action of metallic carbonyls by Mr. H. W. Armit appeared in the November issue (1908) of the *Jour. of Hygiene.* We referred to his previous work on the subject in a leading article in the *Lancet* of September 28th, 1907, in which he showed that the toxic symptoms after nickel carbonyl inhalation were not due to either the nickel carbonyl as such or to the carbon monoxide which is given off when the compound is exposed to air and moisture at body temperature. On the contrary, the conclusion was that the symptoms were occasioned by the absorption of the nickel set free and that nickel carbonyl poisoning is a particular case of nickel poisoning. As Mr. Armit says, the fact that the nickel is deposited over the immense surface of the lungs in a condition which is especially favourable for absorption renders a study of the toxicology of this compound of great interest. The paper is full of interesting experimental details; and some excellent coloured plates are appended illustrating sections of lung, brain, suprarenal gland, and medulla oblongata from animals (rabbit, guinea-pig and cat) poisoned by nickel carbonyl. We must content ourselves by giving a mere summary of the results obtained. In the lungs nickel carbonyl is dissociated and a compound, probably the hydrated subcarbonate, is deposited on the respiratory surface, from which it is dissolved by the tissue fluids and is then taken up by the blood. Some of the nickel finds its way directly through the lymphatic channels into the bronchial glands. In the dissolved condition the nickel enters into complex combination with some constituent of the body. The metal is carried by the blood to the tissues, but a selective absorption is exercised by the brain and adrenals. In some cases the lungs exert a specific selection, but the nickel only stays for a short time in these organs. The specific pathological changes produced are primarily a degeneration of the endothelial cells of the capillary vessels. It is possible that some further primary action is exercised on the ganglion cells in the brain and on the parenchyma cells of the adrenals. Hæmorrhages follow as the result of the fatty degeneration of the vessel walls, and secondary changes result from the effects of the hæmorrhages. Nickel is excreted by the kidneys and intestines. Both cobalt and iron carbonyls act similarly, the latter, however, being less toxic than the other two. Mr. Armit expresses his acknowledgments to Dr. Ludwig Mond, who rendered the investigation possible and who defrayed all the expenses which it involved, and Dr. Ludwig Mond may be congratulated, we may add, on entrusting the investigation to Mr. Armit, who has made public a very successful and interesting piece of research on a problem of considerable hygienic and industrial importance.

Poisoning by Uranium.

The compounds of this metal are now largely used in the arts, and cases of poisoning by them have occurred. Indeed, it has recently been proposed to place them in the list of poisons officially current in Russia. Uranium salts cause severe inflammation of the gastro-intestinal mucous membrane and of the kidneys, and are distinguished from other metallic poisons by acting directly on the walls of the blood-vessels, and by rendering also the blood reducible with difficulty. In this respect they resemble prussic acid (see an abstract of the researches of Woroschilsky in *Pharm. Jour.*, 1890–1, p. 206).

The editor has found no cases reported in English journals.

Group 4.—GASEOUS POISONS.

This group is merely a convenience for exposition. It has no real existence as a special group of pulmonary or respiratory poisons. There are three classes of poisons acting in the state of vapour.

1. The volatile acids acting as intense irritants to the pulmonary mucous membrane, and setting up an intense bronchitis. These have already been considered.

2. Other less powerful irritant gases, such, for instance, as chlorine, fluorine, but acting more by the irritation they produce than by the fact of their being poisonous after absorption.

3. Gases which can be breathed, but after absorption act as definite poisons to the system, typically CO, AsH_2, and the various volatile substances used as anæsthetics, and ordinary coal gas. These are really divisible into two sub-groups: (*a*) those which combine with the hæmoglobin to form too-fixed compounds; (*b*) those which apparently become merely dissolved in the plasma of the blood and poison the tissues to which they are distributed.

4. Absolutely neutral gases, whose sole effect is that they are not oxygen, and cannot take its place, *e.g.* an atmosphere of nitrogen.

Owing to the fact that the poisonous material is in a finely diffused state, and that in the air-cells of the lungs it meets at once with a large absorbing surface, and instantly enters the blood, the effects of gaseous poisons are more rapid and, *cæteris paribus*, more powerful. It has been remarked, too, that with some, and probably all, of them, their effects continue to increase for a short period, even after a person has ceased to breathe them. This is particularly true of the third class, and the explanation is easy to see.

The greater number of the poisonous gases are chiefly complex products of art, and are never likely to be met with in the atmosphere so abundantly as to produce injurious consequences; hence fatal accidents, arising from their inhalation, most commonly occur under circumstances which can leave no question respecting the real cause of death. The peculiar effects of all of them it will not be necessary to describe in this place; but there are some few, a knowledge of the properties and operation of which may, on certain occasions, be required of a medical jurist. Amongst these are carbonic acid, carbonic oxide, and sulphuretted hydrogen gases and ordinary coal gas. Agents of this description can rarely be employed with any certainty as instruments of murder, and if they were so employed the fact could be established only by circumstantial evidence. One alleged instance of murder by carbonic acid is, however, reported by Devergie (“ Ann. d'Hyg.,” 1837, 1, 201). Death, when arising from the breathing of any of the gases, is generally attributable to suicide or accident. In France it is by no means uncommon for a person to commit self-destruction by sleeping in a closed compartment, in which charcoal has been suffered to burn; while in England accidental deaths are sometimes heard of, where coal or coke has been employed as fuel in small and ill-ventilated rooms. On such occasions a person may be found dead without, to the casual observer, any evident cause; the face may appear pale or livid, and the skin may be covered with patches of lividity. The discovery of a body under these circumstances will commonly be sufficient to create a suspicion of murder. In such a case it is obvious that the establishment of the innocence of the accused will depend entirely on the discrimination and judgment of a medical practitioner. An instance, illustrative of the consequences of this popular prejudice, occurred in London in 1823.

Six persons were lodging in the same apartment, where they were all in the habit of sleeping. One morning an alarm was given by one of them, a woman, who stated that on rising she found her companions dead. Four were discovered to be really dead, but the fifth, a married man, whose wife was one of the victims, was recovering. He was known to have been on intimate terms with the woman who gave the alarm, and it was immediately supposed that they had conspired together to destroy the whole party, in order to get rid of the wife. The woman, who was accused of the crime, was imprisoned, and an account of the supposed barbarous murder was soon printed and circulated in the metropolis. Many articles of food about the house were analysed, in order to discover whether they contained poison, when the circumstances were explained by the man stating that he had placed a pan of burning coals between the two beds before going to sleep, and that the doors and windows of the apartments were closed (Christison, p. 583). A set of cases of a similar kind, in which there was at first a strong suspicion of poisoning, has been reported (*Med. Gaz.*, vol. 36, p. 937).

Those which will be here noted are the following:—

CO_2 or carbonic acid.
CO or carbonic oxide.
Fumes from stoves, probably a mixture of CO and CO_2.
Water-gas, probably CO mainly.
Vapours of lime-kilns, etc., probably a mixture of CO and CO_2, etc.
Coal-gas, CO mainly, but probably also other gases.
Sulphuretted hydrogen, SH_2.
Sewer-gas, possibly SH_2, or may be CO or CO_2 or other gases.
Arseniuretted hydrogen, AsH_3.
An unknown gas from dye works.
Compressed air.
Carbon disulphide.
Ferro-silicon.

POISONING BY CO_2 OR CARBONIC ACID.

Sources and Methods of Occurrence.—This gas is freely liberated in respiration, combustion, and fermentation. It is also produced in the calcination of chalk or limestone, and is sometimes diffused through the shafts and galleries of coal-mines, where it is commonly called "choke-damp." Carbonic acid gas is likewise met with in wells, sewers, cellars, and other excavations in the earth, also in old brewers' vats, etc. In these cases it is generally found most abundantly close to the soil, or at the lower part of the well. The slow evaporation of water strongly charged with the gas, while trickling over the sides of these excavations, may likewise assist in contaminating the air. Damp sawdust or straw slowly absorbs oxygen from a confined atmosphere, and sets free carbonic acid.

Poisoning by this gas is, as might be anticipated from its sources, almost entirely a matter of accident, as in brewers' workmen or sewer men when engaged in cleaning out vats and sewers, from which many fatal cases are recorded.

In coal-gas poisoning and in poisoning by the fumes of burning charcoal, etc., it is practically certain that CO has more to do with the fatal effects than CO_2.

In reference to suffocation by carbonic acid, it is a matter of popular belief—and, in fact, it has been often asserted by writers on asphyxia

—that the burning of a candle in a suspected mixture of carbonic acid and air is satisfactory proof that the atmosphere may be breathed with safety. Observations have, however, tended to show that this statement is not to be relied on as affording an indication of security. A case is related by Christison where a servant, on entering a cellar in which grape juice was fermenting, was suddenly seized with giddiness. She dropped her candle on the floor, but had time to leave the cellar and shut the door behind her, when she fell down senseless. Those who went to her assistance found, on opening the door, that the candle was still burning. Other cases are reported in which persons have been discovered to be in a state of deep coma, while a pan of charcoal was still burning in the apartment. The results of some experiments on this subject led the author to the conclusion that a candle will burn in air which contains even 10 or 12 per cent. of its volume of carbonic acid gas; and although such mixtures might not prove immediately fatal to man, yet they would soon give rise to giddiness, insensibility, and ultimately death in those who, after having been once immersed in them, did not hasten to quit the spot. In air containing a smaller proportion than this (5 or 6 per cent.) a candle will readily burn, but it is probable that such a mixture could not be long breathed without causing serious symptoms; hence the *burning of a candle can be no criterion of safety* against the effects of carbonic acid. It is true that in gaseous mixtures, where a candle is extinguished, it would not be safe to venture; but the converse of this proposition is not true—namely, that a mixture in which a candle burns may be always breathed with safety.

Degree of Toxicity and Fatal Dose..—In reference to the fatal proportion of CO_2 in the air breathed, it is absolutely necessary to make a distinction between the contamination of air by the addition of a quantity of free carbonic acid, and the case where this gas is produced by combustion or respiration in a close apartment at the expense of the oxygen actually contained in the air (*vide* Landois and Stirling, "Physiology," p. 196). Every volume of carbonic acid formed by combustion indicates an equal volume of oxygen removed. Such an atmosphere is, *cæteris paribus,* more destructive than another where the air and gas are in simple mixture. If we assume that in each case the noxious atmosphere contains 10 per cent. of carbonic acid, then in one instance there will be nearly 7 per cent. more of oxygen and 7 per cent. less of nitrogen than in the other, since the production of 10 parts of carbonic acid as a result of combustion implies the loss of 10 parts of oxygen. This difference in the proportions may not be, practically speaking, exact, because there is no apartment sufficiently closed to prevent air rushing in from the exterior while combustion is going on within it; but, nevertheless, the above statement may be taken as an approximation to the truth. When the gas is respired in its lowest poisonous proportion the symptoms come on more slowly, and the transition from life to death is frequently tranquil. This is what we learn from the histories of suicides. The symptoms in such cases appear to resemble closely those which indicate the progressive influence of opium or rather narcotic poison on the body.

The statements made by chemists and physiologists respecting the proportions of carbonic acid in air required to produce noxious or fatal effects on human beings are very conflicting. Since physiologists have determined that CO_2 is the natural product of "internal respiration," an enormous amount of experimental and other work has been done on the subject of its excretion. The subject is too physiological for full discussion here, and the reader is referred to text-books on Physiology (M. Foster or Landois and Stirling, Stewart, etc.). In general terms it may be said that the percentage of CO_2 has less to do with a fatal result than the percentage of available oxygen. The fatal proportion of CO_2 in all ordinary cases may be taken at from 10 to 20 per cent., and even less when the carbonic acid has been produced at the expense of the oxygen contained in an enclosed space.

In a case of alleged murder by charcoal vapour in Paris, a question was put to the medical witnesses respecting the *quantity of charcoal* required tc be burnt in a particular chamber in order to asphyxiate two adult persons. This question could of course only be answered approximately; because in burning charcoal, the sole product is not carbonic acid, and the substance itself is not pure carbon. Then, again, much of the carbonic acid formed may escape in various ways from an imperfectly closed apartment. An attempt was made to infer the quantity of charcoal consumed from the weight of ashes found in the apartment, but no satisfactory answer could be given to this question. The prisoner was, however, convicted of murdering his wife by charcoal vapour.

With regard to the dosage of CO_2 (or any other gas for that matter) required for a fatal result, it is useless at a time remote from the accident to make any analysis of the general atmosphere of the place where the fatal event took place. This arises from the well-known laws of the diffusion of gases and the effects of heat upon this diffusion and their expansion. To be of the slightest value as evidence, such analyses must be made (1) from the actual vicinity of the body, and (2) at the moment of discovery, though even this is probably too late.

It is well known, by the effects of the vapour of a lime-kiln, that one person lying at the edge of the kiln may be destroyed, while another at ten yards' distance, either on the same or at a lower level, may entirely escape; and it would not be possible in such a case, to speculate upon the proportion of carbonic acid which had destroyed life, except by collecting the air from the spot where the accident occurred, and at or about the time of its occurrence. Another fallacy appears to be, that because a dead body is found recumbent, it is to be inferred that the person must have lain down and have been destroyed while sleeping. The dead body of a person must always be found thus lying on the floor, unless it be supported; but suffocation may have actually taken place, or at least have commenced, when the deceased was in the sitting or erect posture.

Duration.—The duration of symptoms of poisoning by carbonic acid vary according to the degree of concentration in which it is present in the atmosphere respired. Undiluted carbonic acid gas is respired with difficulty, or not at all, and produces spasm of the glottis, and almost instant death. With less percentages death is slower in onset, though unconsciousness may be very rapid.

Symptoms.—When the gas is respired in a fatal proportion the symptoms commonly observed are as follows:—Sensations of great weight in the head, pressure in the temples, ringing in the ears, with a pungent sensation in the nose; a strong tendency to sleep, accompanied by giddiness, and so great a loss of muscular power, that, if the person be at the time in an erect posture, he instantly falls to the ground as if struck. The breathing, which is observed to be at first difficult and stertorous (snoring), becomes suspended. The action of the heart, which on the first accession of the symptoms is very violent, soon ceases: sensibility is lost, and the person now falls into a profound coma, or state of seeming death. The warmth of the body still continues; the limbs are relaxed and flexible, but they have been observed in some instances to become rigid or even convulsed. The countenance is livid or of a leaden colour, especially about the eyelids and lips, but on some occasions it has been pale and placid. The access of these symptoms is stated to have been sometimes accompanied by a pleasing sensation of delirium, while at others the most acute pains have been suffered. In some instances there appears to have been irritability of the stomach, for the affected person has vomited the contents of his stomach in a semi-digested state. Those who have been resuscitated have felt pain in the head, or pain and soreness over the body for several days; while, in a few severe cases, paralysis of the muscles of the face has supervened on recovery. For other symptoms, *vide* "Asphyxia," Vol. I.

Treatment.—There is only one chance for a victim, and that is to put him into fresh air and employ artificial respiration if necessary. If pure oxygen is obtainable, it may be tried.

Appearances after Death.—The body of a person who has perished from the inhalation of carbonic acid is said to retain the animal heat, *cæteris paribus*, for a longer period than usual; and hence, according to Orfila, cadaveric rigidity does not commonly manifest itself until after the lapse of many hours. In a case to be afterwards related, the body was, however, found to have cooled considerably within the short space of two hours. There is no reason to believe that this mode of death affects the rate of cooling or the access of rigidity. In some instances it is said the face has been found livid and swollen and the features distorted, but more generally it has been pale and placid, as if the persons had died without a struggle in the position in which their bodies were found. The skin is sometimes livid or presents patches of lividity, and the limbs are quite flaccid. The pupils have been found dilated. *Internally*, the venous system is filled with liquid blood of a dark colour. In death from carbonic acid as a result of combustion, the blood has sometimes had a light-red colour; this is due to the co-existence of carbonic oxide in the products of combustion. The vessels of the lungs and brain are observed to be especially in a state of injection. The tongue appears swollen, and it is stated by Orfila that the mucous membrane of the intestinal canal is often interspersed with dark ecchymosed patches. The following appearances were met with thirty hours after death in the bodies of two adults, a male and a female, who died from the accidental introduction of carbonic acid into their bedroom from burning ashes. Externally—there was nothing unnatural, excepting a few slight discolorations on the back of the man. Internally—there was injection of the membranes and great vessels of the brain. Each lateral ventricle contained about half an ounce of clear serum, the lungs were gorged with dark blood, and the lining membrane of the air-tubes (bronchi) was slightly reddened. The left sides of the heart were nearly empty; the right contained a quantity of dark half-coagulated blood. The stomachs were healthy. The bodies were found on the floor of the bedroom in positions of ease. The deceased persons had had the power to get out of bed, but were unable to escape from the chamber. It will be perceived from this description that there is nothing very characteristic in the appearances, and thus it is always easy to ascribe death to apoplexy or some other cause; but it should be remembered that carbonic acid itself is a narcotic poison, inducing cerebral congestion and apoplexy.

[Considering the physiology of respiration, it is not to be expected that there would be any signs beyond extreme darkness of the blood.—Ed.]

Analysis.—Sometimes a medical jurist may be required to state the nature of the gaseous mixture in which a person may have died. He will have but little difficulty in determining whether carbonic acid is or is not one of the deleterious agents in such a mixture. When it exists in a confined atmosphere, its presence may be identified, if previously collected in a proper vessel, by the following characters:—1. It extinguishes a taper if the proportion be above 12 or 15 per cent.; and, from the great density of the gas, the smoke of the extinguished taper may be commonly seen to float on its surface. 2. Lime-water, or a solution of subacetate of lead, is instantly precipitated white when poured into a jar, of the gas; and the precipitate thus formed may be collected by filtration, and proved to possess the well-known properties of carbonate of calcium or lead. Air containing only 1 per cent. of carbonic acid affects lime-water: if it amounts to 2 per cent. a few cubic inches will suffice to show its presence by the lime-water test. The *proportion* in which carbonic acid exists in a mixture may be determined by introducing into a measured quantity, in a graduated tube over mercury, a strong solution of potash. Absorption will after a time take place, and the degree of absorption will indicate the proportion of carbonic acid present. When this gas exists in a confined spot, as in a well or cellar, it may be generally got rid of by placing within the stratum a pan containing slaked lime, loosely mixed into a paste with water; by exciting combustion at the mouth of the pit; or, what is better when available, by a jet of high-pressure steam. Lives are often successively lost on these occasions, in consequence of one person descending after another, in the expectation of at least being able to attach a rope to the body of his companion. The moment that the mouth comes within the level of the invisible stratum of gas all muscular power is lost, and the person commonly sinks lifeless. Carbonic acid may be collected for the purpose of testing by lowering a bottle filled with fine dry sand, by means of a string attached to the neck, and guiding the bottle by another string attached to its base. When the bottom is within the stratum, it should be turned with its mouth downwards; and when the sand has fallen out, it may be rapidly raised, with its mouth upwards, by pulling the string attached to the neck. The bottle should be immediately stoppered, and the contents examined.

Cases.—Cases of poisoning by pure CO_2 are very rare; in almost all the alleged cases CO or SH_2 or other poisonous gases were almost certainly the agents; probably the only genuine ones are those occurring in old brewers' vats, *e.g.*:—

In 1863, a boy mounted on a forty-barrel vat, and while looking through the manhole fell among some wet hops, and speedily died from respiring the atmosphere of carbonic acid. Two men successively endeavoured to rescue the boy, but each died in the attempt. In the same year a man at Bromley descended into a large vat, having previously applied the candle test. He was heard to cry out, "There is gas here," and he instantly fell back dead: he had probably stirred up the contents after he had lowered the candle (*Lancet*, 1864, 2, p. 552). Many other cases of a similar kind are reported. Under these circumstances, the noxious agent is pure carbonic acid more or less mixed with air.

The following, although spoken of as CO_2 poisoning, was probably due to a mixture of gases, with the possible addition of ammonia:—

On May 6th, 1904, three men, on descending into the hold of a vessel which arrived at Leith Docks with a cargo of guano, were overcome by carbonic acid gas, which had generated from the guano, and died, after every means had been adopted to restore them to consciousness. Police Sergeant Hill, who pluckily went to their assistance, also collapsed, but recovered.

The following, from previous editions, the editor thinks suspicious of poisoning more by nitrous fumes than CO_2:—

An old woman occupied a room under one in which there was a quantity of nitric acid kept in store. Owing to some accident a carboy was broken; the acid ran through the ceiling into the room below, acting upon and corroding the bed-coverings of the deceased's bed. As the room was filled with nitrous fumes, a chemist was consulted, and he advised that whiting should be freely used for the purpose of neutralising the acid. This advice was followed, and several persons, who were in the room witnessing the operation, felt oppressed and were obliged to leave it: they were observed to stagger, as if intoxicated, on reaching the street. The room was then completely closed, and the whiting allowed to remain in contact with the acid. The deceased had suffered from diarrhœa for a few days previously, and was obliged to resort to the night-chair, which was in the room in which the accident had occurred. As she remained absent half an hour, some persons entered the apartment, and found her in the chair unable to move. She was taken into another room, and on a medical man being called to her, he found her sleepy, comatose, and her mind confused; there was great difficulty of breathing, and extreme lividity of the face and lips; the arms and legs were cold, and the pulse was full. In spite of efforts made to save her, she died in about an hour from the time at which she had entered the room. Those who found her in the apartment do not appear to have suffered. This was a case of slow poisoning by carbonic acid, for no carbonic oxide could have been evolved from the action of the acid on the chalk. Age, and debility from previous illness, may account for the unusual circumstance that the deceased did not recover on being removed to a pure atmosphere.

POISONING BY CO OR CARBON MONOXIDE OR CARBONIC OXIDE.

Sources and Methods of Occurrence.—Whenever carbon is combusted either at a high temperature or in a limited supply of oxygen some CO is formed, as well as CO_2, hence the principal sources of CO are the vapours from blast furnaces, from charcoal or coke fires. It is also a very prominent poisonous feature in ordinary coal gas, and in water gas is certainly *the* poisonous constituent. Hence the bulk of cases occur from carelessness in leaving stoves alight in a closed bedroom, from deliberate suicidal poisoning by coal-gas, from sleeping near lime-kilns, etc. The danger of water-gas, as of blast furnace vapour, etc., is that there is no smell attached to either CO or CO_2, and hence a man may be poisoned in a very insidious manner.

"The source of the carbonic oxide in the Snaefell mine was finally found to have been a fire in the timber supports in one of the passages. The burning through of these supports had caused the roof to fall, and thus blocked the ventilation. Wood smoke—in other words, the crude gas driven off from heated wood—is intensely poisonous. The large proportion of oxygen contained in wood and similar material gives rise to the presence of a very large percentage of carbonic oxide in the smoke; and it is probable that nearly all the deaths which occur during fires, whether above or below ground, are due to carbonic oxide poisoning. The Snaefell inquiry, however, has furnished the first clear evidence that carbonic oxide is the chief source of danger in the disastrous fires which so frequently occur in mines. In the case of the still more recent fire at Whitwick Colliery in April, valuable additional evidence appears to have been obtained by Dr. Burkitt, of Whitwick, who stated at the inquest that his examination of the blood from all the bodies recovered showed that carbon monoxide poisoning was the cause of death" (*B. M. J.*, 2, 1898, p. 33).

Degree of Toxicity and Fatal Dose.—CO is *not* a natural product of "internal respiration." At the same time it typically possesses the power of forming a fairly stable combination with hæmoglobin, one at least so stable that it cannot easily be broken up by physiological processes in the lungs; hence the very great danger of poisoning by the gas, for the hæmoglobin thus combined is useless for the tissues.

The following analysis (in the "Annual Report on Mines for 1896," by W. N. Atkinson, H.M. Inspector of Mines) is made from the case reported on p. 537. The remarks are from the *B. M. J.*, 2, 1897, p. 27, *vide* also p. 550.

Mr. Atkinson was at the pit when the body was brought up, and noticed the characteristic pink colour of the lips, etc. To make certain as to the nature of the accident, however, he procured a mouse, and took it into the poisonous air. Only a few hours had passed, and the ventilation was unaltered. On seeing the mouse fall over, Mr. Atkinson obtained a sample of the air, and at once retired. Again venturing in, he obtained another sample, this time leaving the mouse, which about twenty minutes later was found to be dead. The samples of air and the body of the mouse were sent to Dr. Haldane for examination. The latter reported that the hæmoglobin of the mouse's blood was 72·5 per cent., saturated with carbonic oxide, and that the samples had the following composition:—

Oxygen	18·05	17·75
Carbonic acid	1·51	1·74
Nitrogen	88·67	78·66
Firedamp	1·60	1·69
Carbonic oxide	0·17	0·16
	100·00	100·00

It thus appeared that along with the carbonic oxide there was a reduction of about 4 per cent. in the oxygen. The effect of this would be to diminish very considerably the mass influence of the oxygen on the hæmoglobin passing through the pulmonary capillaries, and so to increase to a corresponding extent the effect of the carbonic oxide. That this actually occurs in the living body, as well as *in vitro*, was recently demonstrated by Dr. Haldane. In pure air 0·17 per cent. of carbonic oxide would not have proved actually fatal, to judge from the experimental data hitherto obtained. As the lamps of the manager and under-manager were not extinguished by the air, and as a lamp goes out when the oxygen percentage falls to 17·3, which is very little less than what was present in the samples, it seems hardly possible that the air which proved fatal could have been appreciably more vitiated than the samples themselves.

This case, therefore, appears to show that as little as about 0·17 per cent. of carbonic oxide may prove fatal to a man when the oxygen percentage is at the same time so far diminished as just to allow a candle or lamp to burn. The fact that Redhead lost consciousness on returning, for the third time, into the fresh air is in accordance with what has been very frequently observed in similar cases, but no satisfactory evidence has yet been obtained as to the reason why sudden exposure to fresh or cool air so frequently produces dangerous effects.

In a somewhat similar case, fatal to nineteen miners, in a lead mine in 1897, Dr. Haldane's report is as follows (*B. M. J.*, 2, 1898, p. 33):—

The samples, together with the bodies of two mice which were lowered into the poisonous atmosphere by Dr. Le Neve Foster when he arrived, were forwarded from the Home Office to Dr. Haldane, who found that the hæmoglobin in the blood of both the mice was about 80 per cent. saturated with carbonic oxide, and that the gas had the following composition:—

	Sample 1.	Sample 2.
Oxygen	15·48	15·52
Carbonic acid	4·22	4·26
Carbonic oxide	1·07	1·10
Hydrogen	0·48	79·12
Nitrogen and argon	78·75	
	100·00	100·00

He reported that "the composition of the sample corresponds to a mixture produced by the combustion of wood or other similar material. Inhalation of air of this composition would produce helplessness (in a man) within about seven or eight minutes at most, and would soon cause death. A candle would not burn in such air, but would just do so on addition of a third of its volume of fresh air. The mixture would then still be intensely poisonous, and would still be so if diluted with four times its volume of fresh air. When diluted with nine times its volume of fresh air it would still be capable of rendering a man unable to walk" (*vide* also Dr. Haldane, "The Causes of Death in Colliery Explosions and Underground Fires").

Duration.—The symptoms will commence within a very few seconds of breathing CO, and if the proportion of gas is at all high, say as much as 1 per cent., they will very rapidly mount to a severe degree (*vide* Cases). It is probable that five minutes' exposure to 1 per cent. CO would inevitably be fatal, but the time would obviously vary with the percentage. In the ordinary cases in bedrooms, etc., data are seldom available for deciding the question. Letheby found that 2 per cent. killed a guinea-pig in two minutes and ½ per cent. killed birds in three minutes. Sir Thos. Stevenson found ½ per cent. fatal to mice. The action of carbonic oxide on the body is that of a pure narcotic poison. Tourdes has ascertained that rabbits died in twenty-three minutes when kept in an atmosphere containing one-fifteenth of its volume of pure carbonic oxide, when the proportion was one-thirtieth they died in thirty-seven minutes, and when one-eighth in seven minutes. Even so small a quantity as $\frac{1}{10}$ per cent. is noxious to animals. The animals showed no sign of pain; they fell insensible, and either died at once without convulsions, or they gradually passed into a state of profound coma.

Symptoms.—One of its first effects is to create an utter prostration of strength, so that even in a person awake and active the gas may speedily produce perfect inability to move or to call for assistance. Sir Thos. Stevenson has had personal experience of this. In one instance a charcoal brazier was left, only for a short time, in the cell of a prison. It was removed, and the prisoners went to sleep. They experienced no particular effects at first, but after some hours two were found dead. Thus, then, an atmosphere which can be breathed for a short time with impunity may ultimately destroy life.

Carbonic oxide when inhaled for a short time produces headache, pulsation in the temples, giddiness, nausea, vomiting, and great prostration. These symptoms are followed, in fatal cases, by insensibility and coma. Convulsions have also been observed. The blood is brightened in colour by this gas, while it is darkened by carbonic acid. The bright red colour is due to CO-hæmoglobin, which is a stable and comparatively permanent body. It has been found as long as three weeks after death.

For a very graphic account of the symptoms, *vide B. M. J.*, 2, 1898, p. 33. Dr. Le Neve Foster says there:—"The poison took effect most suddenly; probably its action was accelerated by the exertion of climbing rapidly. I felt decidedly queer when I reached the 115 fathom level, and thought a drop of brandy might revive me. I took out my little brandy flask, but already my fingers seemed incapable of doing the work properly, and someone unscrewed the stopper for me. I took a small sip and sat down. Everything then seemed in a whirl, and the atmosphere seemed to be a dense white fog. This must have been, so far as I can judge, a little before 1 p.m. . . . Sitting next to me was Mr. Williams, and within a few feet were Captain Reddicliffe and Henry Clague; the men who had remained all the time at the 115 fathom level, or at all events had not descended as low as we did, had started to climb to the surface, but of their starting I have no recollection. A curious fact is that we all sat without moving or trying to escape; the foot of the ladder was close by, yet none of us made any effort to go to it and ascend even a single rung. We none of us tried to walk a dozen steps, which would have led us to the other side of the shaft partition, where we all knew that there was a current of better air. We simply sat on and on."

Treatment.—This is, unlike that in CO_2 poisoning, of but little avail, but if time be allowed, fresh air or pure oxygen and artificial respiration are the only available means. The cause of this lack of result resides in the fact already noted, that O cannot drive out CO from its combination with hæmoglobin, and CO-hæmoglobin is useless if not actively poisonous. Ammonia, strychnine, hypodermically, and other rapidly diffusible stimulants should be tried if available.

Post-mortem Appearances.—Beyond the bright red colour of the blood, there are no appearances either suggestive or indicative of CO poisoning.

Full details of the post-mortem appearances met with in poisoning by coke-fumes and the vapours of burning charcoal, are given by La Harpe (*Rev. Méd. de la Suisse Rom.*, 1885, p. 101), and by Cullingworth (*Med. Chron.*, 2, p. 80).

Analysis.—The presence of carbonic oxide in the blood and blood-tinged fluids from the viscera may be demonstrated in various ways. 1. By the persistent vermilion-coloured hue of the fluids. 2. By the spectroscope the two bands of carbonic oxide hæmoglobin are seen to be more refrangible than those of oxy-hæmoglobin. In making the examination it is best to use a spectroscope which enables the operator to view the two spectra superposed—that of the blood under examination, and that of normal blood. The differences in refrangibility of the bands of oxy-hæmoglobin and of carbonic oxide hæmoglobin are then clearly seen. 3. The non-disappearance of the two-banded spectrum with the appearance of a one-banded spectrum, on the addition of a reducing agent. Stokes's solution is best for this purpose when the blood is fresh. 4. The persistence of the florid colour, and of the two-banded spectrum, for days and even weeks, even when the blood through decomposition smells strongly of sulphide of ammonium (sulphuretted hydrogen). In order to test the irreducibility of the carbonic oxide hæmoglobin, Stokes's solution is now no longer admissible, since it blackens when brought into contact with the putrid blood. Yellow sulphide of ammonium is at this stage the best solution to use for the purpose. 5. Ordinary blood when mixed with a 30 per cent. solution of caustic soda and stirred, forms greenish streaky clots, whereas blood charged with carbonic oxide affords reddish streaky clots. 6. Normal blood when diluted with fifty times its volume of water, and then treated successively with yellow sulphide of ammonium in the proportion of two drops to a fluid ounce, followed by three drops of ordinary B.P. acetic acid, affords a grey colour, whereas carbonic oxide blood similarly treated affords a bright red coloration. *Vide* also works on Physiology (Landois and Stirling, Foster, etc.).

Cases.—In his annual report for 1896, Mr. W. N. Atkinson, Her Majesty's Inspector of Mines for North Staffordshire, gives a detailed account of an accident which unfortunately led to the death by carbonic oxide poisoning of a young mining engineer of great promise, the manager of Stutton Rosshurst Colliery. The cause of death was investigated with great skill and thoroughness by Mr. Atkinson, and is of special medical interest on account of the smallness of the percentage of carbonic oxide which proved fatal. The manager, who was accompanied by the under-manager, James Redhead, had to examine a disused part of the mine, and in the course of this work endeavoured to pass along a passage nearly half a mile in length leading to one of the shafts. When within about a hundred yards of the fresh air at the end of this passage both men began to feel much exhausted, and the manager was unable to get further. After doing all he could to help him Redhead struggled on alone into the fresh air. As soon as he had recovered sufficiently to be able to walk he returned and succeeded in helping the manager to within ten or fifteen yards of the fresh air, but he again fell, and was only able to crawl out. With undaunted courage he went back a second time, but the manager was now unconscious, and Redhead had not strength to move him, and on returning to the fresh air he himself became unconscious, and remained so for some time. When he came to himself he succeeded in summoning assistance, but the manager was found to be dead (*B. M. J.*, 2, 1897).

Vide also *B. M. J.*, 2, 1898, p. 32, for the Snaefell case, report by Prof. Le Neve Foster.

POISONING BY FUMES FROM STOVES.

In many of the cases of poisoning by charcoal vapours, the effects seem to be due to both CO and CO_2.

Cases.—A man was cleaning the windows of three small rooms on the basement-floor of a house. The first room had a door opening into a court-yard; the others merely communicated with each other by a central door, and there was no fireplace in any one of them. A brazier of burning charcoal had been placed in the outer room for the purpose of drying it, but it appeared that the deceased had shut the outer door, and had removed the brazier into the inner room of the three, leaving the communicating doors open. In *two hours* the man was found quite dead, lying on the floor of the middle room. The countenance was pale, as well as the whole of the skin: the eyes were bright and staring, the pupils widely dilated, the lips bloodless, the jaws firmly fixed, the tongue protruding; and the face and the limbs were cold. Some frothy mucus had escaped from the mouth. The person who discovered the deceased, found the ashes in the brazier still burning, and he experienced great oppression in breathing. An inquest was held, without an inspection of the body, and a verdict of "accidental death" returned. The body was afterwards inspected. On opening the head, the vessels on the surface of the brain were found much distended with dark liquid blood; the pia mater was bedewed with serum. The brain was of unusually firm consistency, and numerous bloody points appeared on making a section of it. The lateral ventricles were distended with about an ounce and a half of pale serum, and the vessels of the choroid plexus were much congested. The cerebellum was firm, and presented on section numerous bloody points. About two ounces of serum, tinged with blood, were collected from the base of the skull. The lungs had a slate-colour. On the left side of the chest there were eight ounces of serum, tinged with blood, and nearly an equal quantity on the right side. On cutting into the organs, a large quantity of serous fluid mixed with blood, escaped. The bronchial tubes were filled with a frothy fluid tinged with blood. The pericardium contained an ounce of pale serum; the heart was enlarged—its cavities contained no blood: the liver and kidneys were, however, much gorged. There was no doubt that the cause of death was the inhalation of charcoal vapour; and it is probable that the man died from breathing but a comparatively small proportion. The capacity of the chambers must have nearly reached two thousand cubic feet; the deceased had been there only two hours, and when the person who discovered him entered the rooms, the air was not so vitiated but that he could breathe, although with some oppression. The fuel was then in a state of combustion.

In a case of death from charcoal-vapour, which was referred to Paget and the author, there was a considerable effusion of blood in the sub-mucous tissue of the stomach. This appearance led at first to a strong suspicion of irritant poisoning. A full investigation of the circumstances, however, showed that the suspicion was unfounded. The vapour had descended through a flue communicating with the bedroom in which deceased slept with her husband: it destroyed the wife, and nearly killed the husband. A stove with burning charcoal had been placed in the room above that in which the couple slept, and an iron pipe conveyed the products of combustion into a flue, whence they descended into the bedroom and caused the fatal accident. It is sometimes difficult to account for the mode by which these gaseous mixtures find their way into an apartment. In the above-mentioned case there was great difficulty in procuring correct information. There was neither fire in the bedroom nor any source of combustion, and this at first strengthened the suspicion that the husband must have poisoned the wife at their supper on the previous night. Devergie relates a somewhat similar case, in which the wife was found dead in bed, while the husband, lying by her side, was in a state of unconsciousness, from which he did not recover until the next day. In this case there was no stove nor fire, nor any source of combustion in the room. The noxious gases must have leaked into the room through the fissures in a chimney adjoining it ("Ann. d'Hyg.," 1871, 2, 441). A mother and daughter went to bed. In the morning, the daughter was found on her face dead—the face livid, and there had been copious bleeding from the nose. The mother was insensible, and recovered only after many hours under treatment. The cause of the accident was traced to an imperfect joint in a furnace-flue, which passed through the bedroom to a chimney. This adjoined their bed, and the leakage took place directly upon them. The door was shut, and the smell, when first perceived, was supposed to come in from the outside (*Med. Gaz.*, vol. 47, p. 412).

The case of the late Mr. Quintin Hogg, who was asphyxiated in 1903, at the Polytechnic, in the course of having a hot bath, deserves to be mentioned in order to emphasise the danger of geysers in closed bathrooms without proper ventilation for the waste products of combustion of the gas. His death otherwise is only one of a large number of such accidents occurring annually. It was attributed to the "products of the incomplete combustion from a gas heater." Zola, the eminent French author, met with a similar fate in 1902 from a charcoal stove.

Poisoning by Water-gas.

Source and Method of Occurrence.—Recent successful attempts to introduce water-gas into this country and into the United States of America, as a heating and illuminating agent, have given rise to serious accidents. Water-gas, made by passing steam over hot coke, is essentially a mixture of hydrogen and carbonic oxide gases, and contains about 40 per cent. of the latter gas. It is odourless, and highly poisonous. Many fatal accidents have occurred in the United States of America from its escape into the air of rooms.

For Toxicity, Symptoms, etc., *vide* "CO Poisoning."

Cases.—On Nov. 20, 1889, two forgemen, French and Fenwick, occupied a cabin in which there was a cooking-stove heated by water-gas. By an accident the gas was extinguished, the tap being left partially turned on. In the course of the day they were found dead, as if asleep. Two days later the bodies were examined by several medical men in a room of 39,000 cubic feet capacity, and receiving perhaps 1,000 cubic feet of fresh air per minute. Before the bodies were well opened, several of those engaged were affected by the gas, which was escaping into the room, and one seriously. All recovered. Two days after this, and four days after the deaths occurred, Sir Thos. Stevenson assisted at the post-mortem examinations, which had been abandoned on the previous occasion. The appearances were typical of those from carbonic oxide poisoning, viz., a rosy hue of the viscera and of the post-mortem hypostases (ecchymoses), a fresh appearance of the viscera, an exudation of rosy blood-stained fluid into the stomach, bladder, and cranial cavity. The rosy hue of portions of the viscera was clearly visible seventeen months later, though the organs were simply kept in glass-stoppered bottles. The blood also retained its rosy hue for many weeks, and throughout this time showed the two absorption bands of carbonic oxide hæmoglobin (Guy's Hosp. Rep., 1889, p. 223).

At a meeting of the Royal Academy of Medicine, in Ireland, in May, 1904, Prof. McWeeney brought forward no less than seven fatal cases in three years. He gave full details, and laid special stress on the presence of CO-hæmoglobin in the bodies. In the first group the family of four lived in a house where gas was not used and there were no fittings. The gas had penetrated into it from a broken main in the street, with the result that one of the persons was found dead, and the others were more or less collapsed. The hæmoglobin in the fatal case contained much carbon monoxide. In the second group an attempt had been made to defraud the gas company by leading the gas into the house without it passing through the meter. The indiarubber tube used in the attempt had slipped off, with the result that the family of three persons were asphyxiated in their sleep. The third group of cases was that of a man and his wife who were suffocated in a bedroom at a Dublin hotel by gas escaping from a wall-bracket, the stop-cock of which was half open. The last case was that of a young man who was asphyxiated in his bath by the carbon monoxide contained in fumes escaping from a badly constructed and unventilated "geyser." The hæmoglobin in this case was loaded with carbon monoxide (*Lancet*, 1, 1904, p. 1427).

For references to inquests on thirty-three cases, *vide B. M. J.*, 1, 1897, p. 1308. In 1909 several cases occurred in Belfast and led to an inquiry into the question.

POISONING BY VAPOURS OF LIME-KILNS, ETC.

These are really cases of CO and CO_2 poisoning, but the editor feels that Dr. Taylor's remarks should be preserved.

In the burning of lime, carbonic acid is given out abundantly; but, owing to the nature of the fuel used, carbonic oxide and sulphurous acid are mixed with the gas. Persons who have incautiously slept in the neighbourhood of a burning lime-kiln during a winter's night, have been destroyed by the respiration of these gases. The discovery of a dead body in such a situation would commonly suffice to indicate the real cause of death; but a practitioner ought not to be the less prepared to show that there existed no other apparent cause of death about the person. It is obvious that a person might be murdered, and the body placed subsequently near a kiln by the murderer in order to avert suspicion. If there are no marks of external violence, the stomach should be carefully examined for poison; in the absence of all external and internal injuries, medical evidence will avail but little; for a person might be criminally suffocated, and his body, if found under the circumstances above stated, would present scarcely any appearances upon which a medical opinion could be securely based.

The vapours of *brick-kilns* are equally deleterious, the principal agents being carbonic acid and carbonic oxide; although, according to the state of combustion of the fuel, ammonia, hydrochloric acid, sulphuretted hydrogen, and sulphurous acid may be also evolved. In 1842, two boys were found dead on a brick-kiln near London, whither they had gone for the purpose of roasting potatoes. Although the cause of death in the two cases was clearly suffocation, in one instance the body was extremely livid, while in the other there was no lividity whatever. Such accidents are frequent.

Brick-kilns are frequently the subjects of injunction or action on the ground of their being public *nuisances*. There can be no doubt that the vapours which they give off are noxious, *i.e.*, injurious to health as well as offensive, and that they create great discomfort. They contaminate the air, and render it unfit for respiration. In contested cases the medical and general evidence is often very conflicting. In one, *Re Tassell*, 1867, Wood, V.-C., in granting an injunction, justly observed that brick-burning was not the less a public nuisance because certain individuals were so peculiarly constituted as not to object to it, the real question being how far it affected the generality of persons of ordinary habits. The vapours of *cement-kilns* are quite as noxious as those of brick-kilns: carbonic and sulphurous acids predominate in them.

Poisoning by Coal-gas.

Source and Method of Occurrence.—Coal-gas, as is well known, is the product of distillation of coal. Its composition is very variable. An analysis of coal-gas, as supplied in London, shows that it contains per cent.—of hydrogen, 46·43; of marsh gas, 3·89; carbonic oxide, 5·62; olefiant gas, 3·86; watery vapour, 2·48; nitrogen, 2·22; carbonic acid, ·46. Carbonic oxide is the chief poisonous substance in coal-gas; but there is little doubt that the heavier hydrocarbons also have a noxious influence.

Poisoning by it is almost always due to carelessness in turning off gas-pipes at night, or to deliberate suicide (*vide* cases). The following incident, reported from America, is instructive:—

> The main from the gasworks was suddenly turned off in the middle of the night, with the result that when the gas was turned on again, every household supplied by the main was in danger either of poisoning or explosion.

In 1901, coal-gas was responsible for thirty-one deaths, of which seven were suicidal. It seems to be increasing in favour, to judge by the newspaper reports of suicides.

Coal-gas owes its peculiar odour chiefly to the vapour of naphtha, which thus indicates its presence. The odour begins to be perceptible in air when the gas forms only the 1,000th part; it is easily perceived when forming the 700th part; but the odour is strongly marked when it forms the 150th part (Tourdes). Some persons can detect 1-10,000th part in air by the sense of smell. In most houses in which gas is burnt, the odour, owing to leakage, is plainly perceived; and it is a serious question whether health and life may not often be affected by the long-continued breathing of an atmosphere containing but a very small proportion of gas. The odour will always convey a sufficient warning against its poisonous effects. It should be known that this gas will penetrate into dwellings in an insidious manner.

Toxicity and Fatal Dose.—Little can be said on this point. They probably closely correspond to those of simple CO.

It is impossible to determine exactly what proportion of this gas in air will destroy life. An atmosphere containing from 7 to 12 per cent. has been found to destroy dogs and rabbits in a few minutes; when the proportion was from 1½ to 2 per cent. it had little or no effect. With respect to man, it may destroy life if long breathed when forming about 9 per cent., *i.e.*, when it is in less than an explosive proportion.

In the manufacture of coal-gas the proportion of carbon monoxide seems to be on the increase, the deficiency of illuminating power being supplied by the addition of an "enricher." In consequence of this excess of carbon monoxide, a leakage of coal-gas, barely recognisable by the smell, is distinctly dangerous to health. Lamie in 1891 showed that carbon monoxide could be obtained from the desanguinated brains of dogs killed by the gas. That carbon monoxide is readily taken up by nerve tissue has been further proved by Croizet, of Paris, who has shown that, after the acute symptoms of poisoning by the gas have passed away, secondary manifestations may appear in the form of peripheral neuritis and trophic lesions (*Lancet*, 2, 1903, p. 1798).

Chronic poisoning by illuminating gas has been carefully studied by Dr. J. C. Bayley, of New York. He found that the prominent symptoms were anæmia, albuminuria, and occasionally enlargement of the spleen, causing a simulation of malaria. The patients improved or quite recovered on being removed to a pure atmosphere. The poisoning was caused by gas having leaked slowly from mains and service pipes, sometimes in such small quantity as to give no warning by the smell. Dr. J. T. Yarrow, jun., has described similar cases. In two cases he detected carbonyl hæmoglobin in the blood, and in one case in the urine. It is noteworthy that coal-gas contains 7 per cent. of carbon monoxide, and recently manufactured water-gas (New York illuminating gas) from 30 to 45 per cent. (*Lancet*, 2, 1902, p. 1772).

Duration and Onset.—The same as those of CO so far as is known.

Symptoms.—The symptoms produced by coal-gas, when mixed in a large proportion with air, are—giddiness, headache, nausea with vomiting, confusion of intellect, loss of consciousness, general weakness and depression, partial paralysis, convulsions, and the usual phenomena of asphyxia. In 1902 the editor met with a case in a baby in which the principal symptom, in fact the only one, was vomiting (*vide* cases). Insensibility may be an early symptom in a very diluted atmosphere, and unless the person is speedily removed into fresh air he will die. In one case, a man entered a large open pipe four feet in diameter, which had been used for gas, to look for a leak. He thought all the gas had been let off. On entering the pipe he perceived a strong smell, and remembered nothing further. He was taken to the infirmary in an unconscious state, suffering from violent muscular contractions. He recovered in two days (*Lancet*, 1870, 2, p. 816). The breathing of this gas renders a man entirely powerless to give any alarm or make any effort to save himself. Stupefaction, and a loss of all muscular power, speedily follow the inhalation of diluted coal-gas ("Ann. d'Hyg.," 1870, 1, p. 60). Convulsions are sometimes seen (*vide* cases).

Treatment.—Precisely the same as for CO poisoning.

Post-mortem Appearances.—The appearances after death will be understood from the following cases:—A family breathed for forty hours an atmosphere contaminated with coal-gas which had escaped from a pipe passing near the cellar of the house in which they lodged. On the discovery of the accident four of the family were found dead. The father and mother still breathed; in spite of treatment the father died in twenty-four hours, but the mother recovered. When the five bodies were inspected, there was a great difference in the appearances; but the principal changes observed were, injection of the brain and its membranes—the pia mater (inner membrane) being gorged with blood, and the whole surface of the brain intensely red. In three of the cases there was an effusion of blood (coagulated) on the dura mater and in the spinal canal. The lining-membrane of the air-passages was strongly injected, and there was spread over it a thick viscid froth, tinged with blood; the substance of the lungs was of a bright-red colour, and the blood in the vessels was coagulated ("Ann. d'Hyg.," January, 1842). In two cases (Guy's Hosp. Rep., 1839, p. 75), there was found congestion of the brain and its membranes, with injection of the lining-membrane of the air-passages; and the blood was remarkably liquid. In addition to these effects noticeable to the eye, the nose will perceive a very strong smell of coal-gas on opening the body if there be not too long delay. There is nothing at all distinctive except the smell, for the blood may be dark instead of red, as in the following:—

A gasfitter accidentally breathed coal-gas while connecting a tube with a meter. The skin was cold, the cornea glazed and the face pale and placid; there was some froth about the mouth, the pupils were rather dilated, and the limbs supple. There was a strong smell of gas in the place. He was working in a closet, and he was found insensible on the top of a pair of steps in a sitting posture, his head on one side, his arms hanging down, and his back leaning against the wall, in the attitude in which he had been engaged at his work. He had evidently died quietly and placidly on his seat, and had made no attempt to descend the steps. He was last seen alive an hour before he was found dead, and he no doubt died rapidly from the inhalation of the gas. An inspection of the body was made twenty-four hours after death. Externally, the skin of the face and upper part of the body was pale, rigidity was well marked, and there was general lividity of the back of the body as well as of the limbs. The blood was everywhere fluid. The brain and its membranes were not congested, but were rather pale than otherwise; the ventricles contained a pale serum. There was a strong odour of coal-gas on exposing the brain. The lungs were of a dark-red colour, and did not collapse on raising the sternum; they were dark at the back of the lobes from gravitation of blood; and their structure was healthy. The windpipe and bronchi contained frothy mucus in some quantity. A powerful odour of gas was perceived on compressing the lungs. The heart was healthy; the right cavities were distended with blood, the left were nearly empty; the blood was everywhere black. There was congestion of the abdominal viscera, but no other unusual appearance ("Med.-Chir. Trans.," 1862, p. 103).

Analysis.—The circumstances under which the accident occurs will generally suffice to establish the nature of the noxious agent. Coal-gas burns with a bright-white light, producing carbonic acid and water. A taper should be cautiously applied to a small quantity; since, when the gas is mixed with the air in the proportion of from 11 to 14 per cent., it is dangerously explosive. For this reason no lighted candle should be taken into an apartment where an escape has occurred, until all the doors and windows have been for some time kept open, and the smell of gas has entirely disappeared. The combustion of the gas, or its explosion with the air, is a sufficient test of its nature; the peculiar odour and the want of action on a salt of lead, if the gas is pure, will distinguish it from sulphuretted hydrogen. Coal-gas when passed through diluted blood turns it crimson, owing to the formation of CO-hæmoglobin.

Cases.—Suicide by coal-gas has become curiously prevalent in the last few years. The following cases could be many times multiplied.

In the Wandsworth Town Hall, on May 2nd, 1904, Mr. John Troutbeck held an inquiry regarding the death of James Cole, aged sixty-one. A son of the deceased said his father had been worried about business matters, and suffered from insomnia, following an attack of influenza, but he had never threatened his life. When the witness last saw him on Wednesday night he was playing cards with a friend. The widow stated that on Thursday morning she sent her little daughter to the deceased asking whether he was going to get up for breakfast. She returned and said, "Mamma, dada has got a piece of tubing in his mouth, and he is dead."

Witness ran into her husband's room and found the bed-clothes over his face. Gas was escaping from a piece of india-rubber tubing, which her daughter had removed from his mouth, and it was connected with tho gas-jet. Dr. Freyberger said death was due to coal-gas poisoning, and a verdict of suicide during temporary insanity was returned.

Accidents remain as frequent now as ever; the following case is thus reported by Mr. J. T. Jackson (*Lancet*, 1896, p. 1792). It shows some rather unusual symptoms.

Two servants, tho elder aged fifty-six years and the younger aged fourteen years, were in the habit of sleeping togothor in a small, badly ventilated bedroom without a fireplace, and in which there was a gas bracket by the window. They were forbidden by their mistress to use the gas, and were supplied with a small safety oil-lamp and a candlestick. On the morning of April 25th, about seven o'clock, as they did not appear to be getting up at their usual time, their mistress went up to their bedroom and immediately smelt a strong smell of gas, and upon their door being opened found the room full of it. Ono of the sons coming to hor assistance opened the window and turned off the gas-tap, from which it had been escaping. Upon looking round they saw the elder patient lying half out of the bed and dead, but seeing that the younger one was still breathing they carried her into the next room, placed her on the bed, and opened the window. Mr. Jackson was summoned a little before 8 a.m. and found the woman dead, so he attended to the girl immediately. He found her lying on the bed quite unconscious, with the pupils widely dilated, the conjunctivæ injected and the extremities cold. The face was pallid, but not dusky, neither were the lips. The breathing was quick, but not laboured, and the pulse was quick and feeble. Hot bottles were applied to the feet and legs and blankets thrown over them and mustard plasters to the chest, the heart, and the back of the neck. She was given some sal volatile and water by the mouth without difficulty. Shortly afterwards convulsions came on, affecting the facial muscles, with closure of the jaws, and also both arms and hands. The legs did not appear to be affected. With the assistance of another practitioner, who had also been called in, artificial respiration was performed for a time, but as there seemed to be no difficulty in breathing this was left off. Hot coffee was given per rectum, and as the convulsions still continued bromide of potassium and brandy were injected by the rectum at intervals of threo hours. The convulsions wero accompanied by restlessness and some moaning. There was no return of consciousness, and she remained in this condition until 6.30 p.m., when the breathing became more hurried, she coughed up blood-stained, frothy mucus, her face became covered with perspiration, and the pulse becoming more rapid she died about 10 p.m. There was no post-mortem examination. On examining tho servants' room the candle was found quite burnt down in the candlestick. The supposition is that the woman had been sitting up late, burnt out the candle, had lighted the gas and had not properly turned it off, or in attempting to do it had turned it slightly on when the flame went out.

POISONING BY SULPHURETTED HYDROGEN (SH_2).

Source and Method of Occurrence.—Solutions of this gas and the gas itself are largely used as a testing reagent in chemical processes, and it is manufactured in proportionate commercial quantities. It is also found with other gases in sewers and privies, etc., and is one of the deleterious components of exhalations from these places helping to produce symptoms in men working in them.

The men who were engaged in working at the Thames Tunnel suffered severely, during the excavation, from the presence of this gas in the atmosphere in which they were obliged to work. The air, as well as the water which trickled through the roof, was found to contain sulphuretted hydrogen: it was probably derived from the action of the water on iron-pyrites in the clay: it issued in sudden jets. Poisoning by this gas is always either accidental or (very rarely) suicidal. The very offensive odour which a small portion of it communicates to a large quantity of air is sufficient to announce its presence, and thus, with due caution, to prevent any dangerous consequences. The *Lancet*, 1, 1903, p. 225, contains an interesting article on the subject by Thos. Oliver; three fatal cases are there reported, with experimental observations on the cause of death.

Toxicity and Fatal Dose.—When breathed in its pure state it is said to be instantly fatal. The editor thinks this may be true, though he is unable to find any corroborative evidence. Parent-Duchatelet observed that workmen breathed with impunity an atmosphere containing 1 per cent. of sulphuretted hydrogen; and he states that he himself had breathed, without serious symptoms ensuing, air which contained *three per cent.* [but *vide* below, p. 550.—Ed.]. In drains and sewers, rats and other vermin are found to live in large numbers; and, according to Gaultier de Claubry, when the air in these localities contains from 2 to 8 per cent. of this gas (Devergie, "Méd. Lég." vol. 2, p. 520). Thus sulphuretted hydrogen does not appear to be so energetic as Thénard's experiments would lead us to suppose. An atmosphere containing from 6 to 8 per cent. of the gas might speedily kill, although nothing certain is known of the smallest proportion required to destroy human life. One fact, however, is worthy of attention, namely, that the breathing of an atmosphere only slightly impregnated with the gas may, if long continued, seriously affect a person, destroy health, and even cause death. [Such was Dr. Taylor's statement, but his evidence is inconclusive.—Ed.]

In fatal cases Dr. Thos. Oliver found that methæmoglobin was always present, but he hesitated to ascribe death to this fact (*Lancet*, 1, 1903, p. 225).

Labourers in chemical works are quite familiar with sulphuretted hydrogen gas and its usual effects on the system; for it is not by any means unusual for persons exposed to its fumes to become "gassed" —that is, they pass into a condition of insensibility which lasts a variable time, and when coming round they are very often sick and dazed, and have a sense of oppression about the chest, and there is often a good deal of prostration for a day or two afterwards. Sometimes, indeed, though very rarely, the insensibility ends in death. It is, however, very unusual for lasting or permanent effects to be produced upon the nervous system such as come under the designation of insanity. Indeed, I am not aware that any such cases have been recorded before (Wiglesworth, *B. M. J.*, 2, 1892, p. 124).

Duration.—The symptoms appear very rapidly when the gas is present in anything like large quantities, and rapidly prove fatal. In cases where the gas is more diluted the symptoms occur much more slowly.

As with carbonic acid, an atmosphere containing sulphuretted hydrogen, that may be breathed for a short time with impunity, may ultimately destroy life.

Symptoms.—The symptoms produced by sulphuretted hydrogen vary according to the degree of concentration in which it is breathed. When the air is but slightly contaminated with the gas, it may be breathed for a long time without producing any serious symptoms; sometimes there is a feeling of nausea or sickness, accompanied by ain in the head, or diffused pains in the abdomen. When breathed n a moderately diluted state, the person soon falls inanimate. ccording to the account given by those who have recovered, this tate of inanimation is preceded by a sense of weight in the stomach nd in the temples, giddiness, nausea, sudden weakness, and loss of otion and sensation. If the gas in a still less concentrated state be reathed for some time, insensibility, coma, or tetanus with delirium upervene, preceded by convulsions, or pain and weakness over the hole body. The skin in such cases is commonly cold, the pulse rregular, and the breathing laborious. The symptoms are often bserved to affect those who are engaged in chemical manipulations ith this gas. Sulphuretted hydrogen appears to act like a narcotic oison when highly concentrated, but like a narcotico-irritant when uch dilutedwith air.

In the chronic case of the Thames Tunnel workmen the symptoms re thus described by Dr. Taylor:

> As a result of breathing this atmosphere the strongest and most obust men were, in the course of a few months, reduced to an extreme tate of exhaustion, and several died. The symptoms with which they ere first affected were giddiness, sickness, and general debility; they ecame emaciated, and fell into a state of low fever, accompanied by elirium. In one case, the face of the man was pale, the lips of a iolet hue, the eyes sunk, with dark areolæ round them, and the whole muscular system was flabby and emaciated. Chlorinated lime nd other remedies were tried for the purification of the air; but the vil did not entirely cease until the tunnel was so far completed that here was a communication from one side to the other, and free entilation established throughout.

Wiglesworth alleges that insanity may be the result of the inhalaion of sulphuretted hydrogen, and adduces two cases in support of his view; but the evidence is not thoroughly conclusive (*B. M. J.*, 1892, 2, p. 124).

Treatment.—An immediate removal to pure air, and the applicaion of stimulants, with cold effusion, may suffice to restore life in hose badly affected in the acute form, but in the chronic cases eans must obviously be taken either to purify the air, or if this s impossible, the men must only work for very short periods in the tmosphere.

Post-mortem Appearances.—The gas is *absorbed* into the blood, o which it gives a brownish-black colour by combining with the red lood-pigment, forming SH_2-hæmoglobin, and it is in this state circuated throughout the body. On examining the bodies of persons who ave died from the effects of sulphuretted hydrogen, when breathed n a concentrated form, and the inspection was recent, the following ppearances have been observed:—The mucous membrane of the nose nd throat is commonly covered by a brownish viscid fluid. An ffensive odour is exhaled from all the cavities and soft parts of the ody. These exhalations, if received into the lungs of those engaged n making the inspection, sometimes give rise to nausea and other npleasant symptoms, and may even cause syncope or asphyxia. The uscles of the body are of a dark colour. The lungs, liver, and the soft rgans generally, are distended with black liquid blood. There is also great congestion of the right side of the heart, and the blood has been found everywhere liquid and dark-coloured. The body rapidly undergoes the putrefactive process. When death has occurred from the breathing of this gas in a more diluted form, the appearances are less marked. There is then general congestion of the internal organs, with a dark and liquid state of the blood. In fact, in such cases the appearances can scarcely be distinguished from those produced by carbonic acid. Four men lost their lives in the Fleet Lane Sewer in February, 1861 : they were found dead, and there was no doubt sulphuretted hydrogen was the cause of death. An account of the appearances presented by the bodies was given by Holden and Letheby (*Lancet*, 1861, 1, p. 187). The eyes and mouth were open, the lips and tongue livid, the pupils widely dilated, the blood black and fluid, the lungs congested, the heart full of black fluid blood, the right side gorged, and there was a bloody froth in the windpipe. In the brain the large vessels of the dura mater were full of black fluid blood.

Except for the smell there are no diagnostic features in the post-mortem appearances.

Analysis.—The detection of the gas by the nose is the best test, but corroborative tests may be applied by obtaining the sulphides of three or four metals from solutions of the gas by addition of soluble salts of the respective metals.

Cases.—In 1857, six persons lost their lives at Cleator Moor by the respiration of sulphuretted hydrogen in a diluted form, by reason of their having slept in small close non-ventilated rooms, into which the gas had penetrated. Three of the deceased persons—a husband, wife, and child, of one family—had retired to rest, in their usual health. Two of them were found the next morning dead in bed, and a third (the child) was found in a state of insensibility, and lingered until the afternoon of the same day, when she died. The fourth, a healthy adult, retired to sleep in his bed, with his door closed, and he was found dead in *an hour*. The fifth, a child, was taken ill on the morning of the 11th, and died the same day. The sixth was taken ill on the morning of the 10th, and died on June 12th.

In one child the pupils were found dilated, viscid mucus escaped from the nostrils, and there was congestion of the lungs and kidneys, as well as of the membranes of the brain. In the adult who died in an hour, the pupils were natural, the jaws firmly clenched, the fingers contracted, and the nails blue; there was great cadaveric lividity, and a quantity of fluid with frothy mucus issued from the nostrils and mouth. The lungs were much congested, and serum was effused in the cavity of the chest. The heart contained a little fluid blood, and was somewhat flaccid. The mucous membrane of the windpipe and gullet was redder than natural. In the windpipe there was frothy mucus. The stomach, as well as the large and small intestines, were highly congested, but otherwise healthy. The brain and its membranes were greatly engorged with blood, which, as in the body generally, was very dark and fluid. Wilson, who examined the body of the child, drew the conclusion, which was confirmed by the subsequent inquiry, that death had been caused by sulphuretted hydrogen. Thompson, who examined the body of the man, also inferred that some noxious gas or gases had destroyed life. The cottages in which the accidents had occurred were built upon a heap of iron-slag which also abutted on the premises behind. This slag contained, among other matters, sulphides of iron and calcium. A foul smell, compared to that of cinders extinguished by water, had for some time been perceived about the rooms, chiefly at night, when the doors and windows were closed; and the day before the occurrence a heavy storm of rain had washed through the slag-heap, and aggravated the effects. The heap of slag was burning in certain parts, and sulphuretted hydrogen was evolved in large quantities at a depth of a few feet. A fortnight after the deaths, on removing the flags in the lower rooms, the slag below was found damp, and sulphuretted hydrogen was still issuing from it.

The white-lead paint in the closets was partly converted into black sulphide, and this chemical change was found in patches on the chamber door of one small room in which two persons had died.

The symptoms, so far as they were observed in the survivors, the appearances in the dead bodies, and the chemical nature of the wet slag beneath the foundation, left no reasonable doubt that during the night, with the doors and windows closed, sulphuretted hydrogen had escaped in sufficient quantity to poison the air of a small room and destroy life; and a verdict was returned to this effect. A suggestion was made that carbonic acid might have caused the symptoms and death, but there was no source of carbonic acid but the breath; and there is no instance known of any adult having breathed himself to death in an hour, in a room containing 600 cubic feet of air—not to mention that persons had slept in similar rooms in the same row of cottages, at a distance from the slag-heap, without perishing from such a cause. Another theory was put forward, to the effect that carbonic oxide in the vapours of some blast-furnaces had found its way into the rooms where these persons had died; but the nature of the locality and the distance of the furnaces rendered this impossible. Persons who had left their windows open, whereby these vapours might have freely entered, escaped, while the deaths occurred only in those houses in which the doors and windows were completely closed. It is highly probable that the sulphurettod hydrogen was mixed with other gases and vapours; but tho circumstances left no doubt that it was the principal agent of death. This seems to have been clearly established by the fact, that after a channel had been cut through the slag-heap, and the slag removed, no further accidents occurred.

The following case is unusual in the temporary recovery followed by death:—

While the students at the Industrial Instituto of Lille were engaged in the determination of chemical salts in the Laboratory on Wednesday last, Monsieur Beaubois, aged twenty-two, opened the apparatus in which the sulphuretted hydrogen was being prepared, and immediately fell suffocated to the ground. He was, however, able to get up in a few seconds, wont out into the fresh air, and soon felt better. M. Beaubois had hardly left the laboratory when M. Giraud, aged eighteen, also fell to the ground, although, as it appears, he was standing several yards away from the apparatus. His fall was so violent that it was thought that he had been killed, and he was carried out into the court-yard, where, however, he soon regained consciousness. During more than an hour he walked about the court with the help of his friends, and appeared to have quite recovered. Towards three o'clock in the afternoon, however, he fainted again, and remained unconscious, apparently asleep. The doctor was sent for, and ordered his removal to the hospital, where his case received the greatest attention. He failed, however, to regain consciousness, and died at one o'clock on Friday morning (*Pharm. Jour.*, November, 1899).

POISONING BY SEWER-GAS AND EXHALATIONS FROM DEAD BODIES.

Source and Method of Occurrence.—This is sufficiently explained by the title. The cases are always accidental, though it is easily conceivable that a suicide or a homicide might thus be effected.

In 1838 two persons were killed by the effluvia which had collected in one of the deep graves kept open in Aldgate Churchyard. With ordinary precautions, and the use of deodorisers, the remains of the dead may be removed and transported to other localities without injury to the living. Within a few years many bodies have been thus removed, without ill effects, from London cemeteries, as that of St. Andrew's, Holborn, and St. Pancras (see Devergie in "Ann. d'Hyg.," 1869, 2, 78).

About the latter part of the 18th century, from fifteen to twenty thousand bodies, in almost every stage of putrefaction, were removed from the Cimetière des Innocents in Paris; and the accidents that occurred during the operations, which lasted ten months, were, comparatively speaking, few. The workmen acknowledged to Fourcroy that it was only in removing the recently interred corpses, and those which were not far advanced in decomposition, that they incurred any danger. In these cases the abdomen appeared to be much distended with gaseous matter; when ruptured, there issued a bloody fœtid liquid, accompanied by the evolution of a mephitic vapour—probably a mixture of carbonic acid and sulphuretted hydrogen. Those who breathed this vapour, as it escaped from the body, fell instantly into a state of insensibility and died; whilst others who were at a distance, and who consequently breathed it in a diluted state, were affected with nausea, giddiness, or fainting, lasting some hours, and followed by weakness and trembling of the limbs. Some years since, when it was the practice to bury the dead in the crowded churchyards of London, lives were frequently lost by reason of the noxious gases and effluvia which at once filled every grave as it was made. A grave twenty feet deep was usually dug between strata of exposed coffins, and this grave was kept open until it was filled with bodies.

It is well known that sulphuretted hydrogen in poisonous proportions may easily be given off from the very concentrated sewage contained in cesspools. It is often assumed, however, that the same danger cannot arise from the comparatively dilute liquid contained in ordinary sewers unless acid has been allowed to get into them and to come into contact with deposits containing sulphides, as in the case of the Lambeth accident. Dr. Haldane (*loc. cit.*) says:—"The sewage ordinarily met with in well-built sewers does not contain sulphuretted hydrogen, nor does ordinary sewer air blacken lead paper. It seems probable that so long as sewage is sufficiently aerated there is no evolution of sulphuretted hydrogen, the bacteria simply oxidising the sulphur of the albumen to sulphates, and the carbon and hydrogen to carbonic acid and water, in the same manner as do the tissues themselves in the case of a living animal." The East Ham case (below) is important as showing that under favourable conditions in summer the presence of acids or of sewage as concentrated as that of a cesspool is not essential. Besides sulphuretted hydrogen, almost the only gas likely to be present in poisonous proportions in sewer air is the carbonic oxide of coal-gas. It is well known that coal-gas from leaks in the mains very frequently penetrates into sewers, and occasionally causes explosions. It can usually be recognised by its smell, though this may be absent if the gas has passed through fresh earth, or may be disguised by the smell of sewage. If more than about 5 or 6 per cent. be present, the air of the sewer will be explosive; and as sewer-men must always be provided with lights, the poisonous action of more than 5 per cent. need hardly be considered. Now, as coal-gas itself contains only about 5 per cent. of carbonic oxide, air containing 5 per cent. of coal-gas will only contain about 0·25 per cent. of carbonic oxide. The experiments which I recently described in the *Journal of Physiology* show that 0·25 per cent. of carbonic oxide would be at any rate sufficient to render a man absolutely helpless, so that if in a sewer he would probably be drowned. It would, however, require at least half an hour's exposure to cause any danger. Even with as little as 0·06 per cent. of carbonic oxide, or 1·2 per cent. of coal-gas, a condition would be produced, after an hour or two, in which any xtra exertions, such as that of climbing up a manhole, might give rise temporary loss of consciousness or giddiness and thus easily cause fatal accident. There is, therefore, no doubt that coal-gas may be a ource of serious danger in sewers, quite apart from its explosive roperties, and probably some cases of poisoning have been due it, though so far as I know no such case has been recorded. An bservation of the colour of the blood when diluted to $\frac{1}{200}$th with ater, and compared in a test-tube with the colour of a similarly iluted solution of normal blood, would always decide the question Haldane, *l.c.*).

For a report on the general effects on health of sewer air, *vide ancet*, 1, 1909, p. 1402.

Toxicity and Fatal Dose.—We may state at once that the fatal ose is quite unknown. As regards the toxicity of sewer gases, while SH_2 seems to be the noxious part *par excellence*, the balance cannot be onsidered to be free from suspicion, and it is on this account that sewer-gas poisoning receives some notice apart from SH_2 and CO and Co_2. r. Haldane, in the article below, says "wherever sulphuretted hydrogen s formed in sewage, marsh gas is probably also formed in far greater mount"; the possibility of suffocation from simple deficiency of xygen in the air of a sewer must also be taken into account. In he *Lancet* for January 25th, 1896, p. 220, will be found a long article n the subject by Dr. John Scott Haldane, Lect. in Phys. Univ. of xf., of which the following is a sketch. On July 21st, 1895, five men were killed in an accident at the East Ham Sewage Works. The air in the manhole smelt very strongly of decomposing sewage, but I had frequently been in sewers in which there was an equally unpleasant smell. I was unable to detect in myself any unusual symptoms. A careful analysis of the sample of air gave the following result: oxygen, 20·84 per cent.; carbonic acid, 0·10 per cent.; and nitrogen and argon, 79·06 per cent. As with the same gas-burette fresh air gave 20·91 per cent. of oxygen, it follows that the oxygen in the sample was diminished by 0·07 per cent., and the carbonic acid increased by the same amount. Thus, according to the analysis, the air differed very little from normal air, and was only slightly less pure than that of average well-ventilated sewers such as those investigated by the late Professor Carnelly and myself. The slight vitiation detected by analysis would have required to be more than a hundred times as great to produce any serious action on a man. The result of the examination of the air thus threw no light on the cause of the accident, and was, at any rate, unfavourable to the theory that there had been any dangerous deficiency of oxygen or excess of carbonic acid in the air. The live coals lowered into the manhole at the time of the occurrence burned perfectly brightly, and this fact pointed strongly in the same direction. Flames are extinguished when the proportion of oxygen in the air is diminished by 3 or 4 per cent., though this diminution causes no inconvenience to a man. It is true that if pure carbonic acid be added to air a flame will still burn in it until the atmosphere is such as to be capable of causing extreme respiratory distress and other serious symptoms in a man breathing it; but such an admixture of pure carbonic acid would not occur in a sewer.

Dr. Haldane then proceeded to prove by experiments with the sewage itself and a mouse that the symptoms were due to SH_2. He then discusses the liberation of SH_2 from sewage and its accumulation to a point of danger in the air, which point he puts at 0·07 per cent. on the authority of Lehmann, who says ("Arch. fur Hyg.," 1892, p. 135): "This percentage is just sufficient to cause death after an exposure of about an hour or more in the case of various animals, and doubtless also in man." Lehmann is further quoted: "In one of his experiments on man alarming symptoms were produced within a few minutes by an atmosphere containing about 0·05 per cent. The frequently quoted statement on Parent Duchatelet's authority that a man can breathe 3 per cent. of sulphuretted hydrogen for a short time without injury is certainly quite erroneous; 3 per cent. would cause almost instantaneous death. Lehmann found that 0·2 per cent. was sufficient to kill dogs and cats within one and a half minutes. Lehmann's experiments on man brought out clearly and for the first time the symptoms which are produced in men and animals when the proportion of sulphuretted hydrogen is becoming dangerous. The first symptoms are those of irritation of the eyes and respiratory mucous membrane. In consequence of the irritative action on the air passages there is 'catching of the breath' and diminished frequency of the respiration. With increasing proportions of the gas or longer exposure these symptoms are accompanied by giddiness, etc." Although in the case of the East Ham accident the poisonous constituent in the sewer-air was sulphuretted hydrogen, yet it does not follow that cases of acute gas poisoning in sewers are always due to the same cause. After examining the evidence in several recent cases, however, I am inclined to think that they usually are. On May 4th, 1894, two men were knocked down by gas and drowned in a sewer under the control of the Lambeth Vestry. The case was very thoroughly investigated at the inquest, and, through the kindness of the engineer to the London County Council, I have been placed in possession of the whole of the evidence brought forward. It appeared that three men who had been sent in to measure a sewer were suddenly overcome by gas and fell into the water. Two were drowned, but the third regained consciousness, and succeeded with great difficulty in escaping. The sewer was an old and filthy one, containing much deposit, and it appeared that a quantity of warm water containing about 1 per cent. of sulphuric acid was daily discharged into it from an oil refinery. The man who escaped did not notice the smell of rotten eggs, but observed steam coming down the sewer, and then suddenly experienced a choking sensation and lost consciousness. His silver watch and chain were blackened. A man who afterwards attempted to rescue the other men noticed a smell like that of rotten eggs. He also experienced the choking sensation, became giddy, and had to return. Another man, who went in later, said that the gas made his throat feel dry and his eyes smart. He described the smell as oily. A sample of sewage taken at the same place next day was analysed by Mr. Muter, who found in it 0·13 per cent. of free sulphuric acid and 10 per cent. by volume of sulphuretted hydrogen. Dr. Stevenson, who gave evidence at the inquest, expressed the opinion that the accident was due to dilute sulphuric acid coming in contact with sulphides present in the sewage and thus liberating sulphuretted hydrogen. An accident in the Fleet Lane sewer in 1861 was attributed by Letheby to a similar cause, although the presence of acid was not proved.

Duration.—The above discussion shows quite conclusively that, whatever be the cause of the symptoms, they occur very quickly indeed after exposure to the fumes, and death follows probably within a few seconds, or at most a few minutes, as a rule, though some of those who recovered would seem also to have been exposed for some much longer time. When recovery takes place, it is generally complete in about twenty-four hours, though in the *B. M. J.*, 1, 1896, p. 269, chorea is alleged to have followed a non-fatal case.

Symptoms.—All cases seem to be alike in the rapid onset of powerlessness, which in turn may lead to drowning, etc. In a case of multiple poisoning reported in the *B. M. J.*, 2, 1903, p. 845, it is said of the five men:—

"During their treatment in hospital the clinical features observed were very few, and nothing was discovered which throws any distinct light on the nature of the gas by which the men had been affected. Some of them vomited while in the surgery, and one after removal to the ward, and all of them were in a state of semi-collapse, sufficient in one case to render the use of oxygen desirable. When reaction set in they were all of them very incoherent and drowsy, and remained so until next day, when some complained of much headache."

In 1903 the editor had a case in the London Hospital in which an attack of catarrhal jaundice was distinctly due to sewer gas.

R. G. admitted to hospital, December 12th, 1903. Came over "queer" when at work in a sewer, shook all over, went home, vomited continuously for some hours, and off and on between November 30th, the day of onset, and December 12th, the day of admission, and in addition he had pains in abdomen and in joints. Became jaundiced on December 7th. Motions were white and very offensive. He had been a sewer man thirteen years, and had never had any similar attack. He had a headache on admission, but never showed any convulsions. He was discharged on December 30th quite well, and the jaundice had disappeared. This man said two of his mates had similar attacks to his own.

In Dr. Haldane's case the following symptoms are reported:—

"The rescued man was in a comatose condition when brought up, and never recovered consciousness. He died in the West Ham Hospital almost eighteen hours later. Mr. Blake, resident medical officer to the hospital, kindly furnished me with information as to his symptoms. When he was brought in his respiration was slow and stertorous. There was no corneal reflex. Distinct cyanosis was absent. There were constantly recurring clonic spasms of the arms and legs; these spasms were repeated about every half-minute, and rendered it very difficult to carry out artificial respiration, which was employed for the first two hours. The eyes were frequently directed towards one side. The temperature rose to 102° F. some time after his admission. No symptoms of bronchitis were noticed. There was a discharge from the eyes indicative of conjunctivitis. Urine was passed involuntarily, and none could be collected. Inhalation of oxygen was tried, but without effect. Three hours before death the spasms ceased, and symptoms of œdema of the lungs appeared, and gradually increased."

Treatment.—Precisely the same as for CO, CO_2, and SH_2 in the pure form.

Post-mortem Appearances.—Except for rapid decomposition there is nothing distinctive found. Dr. Haldane thus records the autopsy of the case he dealt with:—

At a post-mortem examination, conducted by Mr. Blake, Mr. J. H. Horton, and myself three days later, no fresh naked-eye changes of any kind were discovered in the organs, with the exception of the lungs, which were more or less œdematous. The blood was normal in appearance, and there were no hæmorrhages or other gross changes in the brain or spinal cord, which were both examined. Unfortunately, decomposition was already far advanced. Dr. Washbourn and Mr. Horton made a microscopic examination of parts of nearly all the organs. They found patches of broncho-pneumonia in the lungs, but no distinctly recognisable fresh changes elsewhere. The brain, spinal cord, liver, kidneys, and heart were all examined. The body of one of the other men was also examined by Dr. Smith. The appearances were such as to suggest that death was due to drowning. I examined a specimen of the blood, and ascertained that no carbonic oxide was present. There were no signs of any abnormality in the hæmoglobin. Four men had thus been drowned while stupefied by the gas, while the fifth had apparently been killed by the gas alone.

Analysis.—The odour of gases and vapours from sewers and from the dead is sufficient to determine their presence, even when they are diluted with a large quantity of atmospheric air. *Sulphuretted hydrogen gas* is at once identified by its action on paper previously dipped in a solution of salt of lead: if present, even in a very small proportion (1-100,000th part), the moistened paper speedily acquires a brownish-black stain from the production of lead sulphide. In a mixed atmosphere of carbonic acid and sulphuretted hydrogen, the two gases may be separated by agitating the mixture with a solution of acetate of lead, and treating the precipitate with acetic acid, which dissolves the carbonate and leaves sulphide of lead.

Dr. Haldane (*loc. cit.*) remarks on the smell:—

"As regards the failure of some of the men to recognise the specific smell of sulphuretted hydrogen, it must be remembered that when it is present in relatively large quantities the smell is not nearly so characteristic. The sense of smell for sulphuretted hydrogen seems indeed to become paralysed, just as occurs in the case of skatol and other very strongly smelling substances. I have myself met with gas (coming from a heated coal-heap) which at once blackened lead paper, but in which I was quite unable to smell the sulphuretted hydrogen. The smell was quite perceptible, however, when I opened in the fresh air a bottle containing a sample of the same gas." CO_2-, CO-, and SH_2-hæmoglobin may be looked for (*vide* above).

Cases.—The following is the one reported upon by Dr. Haldane; it serves as a type of practically all the cases:—

One of the men had gone down the ladder as usual to clear the accumulation from the front of the screen. Before reaching the bottom he said he felt ill and began to return; but when almost at the surface he was overpowered, and fell off the ladder into the sewage, which seems to have been about four feet deep at the time. (It was a rule that the men were not to go down unless the top of the sewer was free, so as to allow of the ventilation being in operation. The ventilating shafts are connected with the crown of the sewer.) A companion who was assisting at the surface immediately summoned help, and with rash but splendid courage three men descended, one after tho other, to the rescue. They were, however, all overpowered and fell off the ladder to the bottom. The engineer in charge of the pumping-station was then called from his office, and seeing one of the men lying on the top of the screen, at once descended to his assistance, but fell off the ladder and was drowned. A bucketful of live coals was now brought from the engine-house and lowered into the manhole. After it had been withdrawn a man went down with a rope round his body, but had to be drawn up again. Another man, also with a rope round him, next went down, and was able to keep his footing. He succeeded in getting a rope round one of the men who, having fallen on the top of the screens, had not been drowned and was still breathing, though quite insensible. The poisonous gas seemed now to have lessened in amount, and the bodies of the other men were soon recovered from the water.

In the following case the actual lethal agent seems to have been doubtful.

A curious case of sewer-gas poisoning occurred lately in connection with some sewerage work in Union Street, Southwark, which entails the substitution of a new for an old sewer. Part of the work is so far complete that the roadway is filled in again, and in this finished section some men had been engaged during the night clearing out odd bricks and accumulated building rubbish. About 7 a.m. they knocked off work and proceeded along the sewer to the manhole. When only a few yards from this, they seem to have walked into an accumulation of sewer-gas, and one after another they dropped down insensible to the number of five. A sixth man, who was only partially overcome, managed to reach the manhole and shouted for assistance, which was quickly accorded by a party of navvies working close at hand. After an unsuccessful effort had been made by one of their number, another navvy, named Leonard Dallimore, got down, taking a rope with him, and one by one sent the men to the surface. During this process he wore no handkerchief nor other face protection, and the time during which he was exposed is uncertain. On completing his task and emerging from the sewer he could only say that he felt "queer," and that he could not have remained down much longer. On being brought to the surface, artificial respiration was applied to the unconscious men by some men of the Fire Brigade, to which an alarm had been given, and as soon as signs of life returned the five men were removed to Guy's Hospital. Under treatment there they quickly recovered, and had all been discharged after three days. No blood from any of the cases appears to have been examined, but spectroscopic examination of the urine of the patients did not afford any evidence of destruction of red blood corpuscles. This negative observation, so far as it goes, seems to contra-indicate sulphuretted hydrogen as the active constituent of the sewer-gas in this case. This is somewhat curious, for it is so constantly present in sewer-gas, and lethal in such minute quantity, that in descriptions of sewer-gas poisoning many writers of text-books confine themselves to detailing the effects of sulphuretted hydrogen alone. It is understood also that Dr. Stevenson went to see these cases, and from their appearance and rapid recovery expressed the opinion that the cause of their collapse in the sewer could not have been sulphuretted hydrogen. The precise cause of their condition therefore remains somewhat of a mystery (*B. M. J.*, 2, 1903, p. 845).

The following account of a case taken from the *Lancet*, October, 1903, p. 1196, shows how these cases may come within the reach of the law. The "verdict of death by misadventure," might easily on medical evidence be converted into one of manslaughter against the persons responsible for the sewerage operations. In the East Ham case the jury did censure the authorities.

The city coroner, Mr. E. A. Gibson, held an inquest on October 14th as to the death of a labourer, named Foley, employed at some chemical works at Clayton, Manchester. He was working at the foot of a well about 14 feet deep when he was overcome by a rush of gas, was drawn up from the well in an unconscious state, and died before a medical man arrived. A witness said that Foley collapsed as he was descending the ladder, and that he himself was overcome when going down to bring him up. Another man tried to reach Foley, but the fumes drove him back. The medical evidence was that death was caused by asphyxiation. After Foley was drawn up one witness noticed a smell of sulphuretted hydrogen. One of the corporation river inspectors said that he had investigated the matter, and after he had taken a rod from one of the six-inch drains there was a rush of greenish liquid containing sulphuretted hydrogen and carbon dioxide. He said that the liquid which went into the drain was not the result of any process of manufacture, "it was drainage from a sump heap." Such a mixture as went into the sewer would give off noxious gases. "The lesson he drew from the occurrence was that the danger could be stopped." He did not think that there was negligence, but with their present knowledge the firm should be expected to make the conditions different. "The presence of the gas in the well could not have been foreseen." Dr. Fowler, chemist to the rivers department of the corporation, agreed with this evidence, and said that in the course of the investigations more than 600 samples had been taken from the well and drains. The coroner said that "it was clear that there was 'carbonite' in this drain and that, coming in contact with the acid, it had created carbon dioxide gas." Whatever the chemical changes may have been, a deadly gas was produced. "The jury could not come to the conclusion that there was anyone to blame so far as the use of the sewer was concerned." The verdict was "Death by misadventure." These deaths from sewer gases, occurring as they do in Manchester too frequently, are greatly to be deplored, for they ought to be guarded against. This was evidently felt by the jury, "who added a recommendation that the corporation should make use of their powers to keep noxious vapours out of the drains and sewers." They also very properly "strongly urged that where wells of this description were used proper appliances should be at hand and that ropes should always be used." These are self-evident precautions which ought not to require enforcing by a coroner's jury, and something might surely be done to drive off noxious gases before the descent of workmen.

For a somewhat similar case *vide Lancet*, 2, 1895, p. 744.

For four series of cases where sewer-gas was or seemed to be responsible for septicæmia, *vide B. M. J.*, 1, 1899, p. 201.

The following occurred at Liverpool, November, 1895; it seems more likely to be a case of CO poisoning than of poisoning by SH_2.

An extraordinary case of suffocation occurred on board the barquantine "Enterprise," of Monckton, New Brunswick. An able seaman named Peter George, about 24 years of age, was ordered to go into a large tank, used for storing water, to see to its condition, and he was suffocated by an accumulation of foul air or gases, occasioned presumably by a fire having been burning in the tank. Another able seaman, named Joseph Keen Lomber, went to assist George, and he also was overcome by the same cause, but he was rescued in time to save his life. Under the care of the medical staff he was soon brought round, and later his condition showed signs of improvement. George's body was conveyed to the Prince's Dock Mortuary to await the holding of an inquest.

An epileptic pauper was set to clean out a large tank used as a cesspool. It contained about two feet of a dark turbid fœtid fluid, and beneath it a layer of thick solid matter. The man fell into this tank. He was rescued in about three minutes, during one-half of which time he was at intervals submerged. When removed he was partially insensible. He was placed in a warm bed, and some brandy was given to him. He was not seen by a medical man for nearly four hours: he was then in a semi-comatose state, with a cold skin, livid face and lips, a feeble pulse, oppressed breathing, with a mucous rattle in the bronchial tubes and windpipe. He vomited a quantity of black fœtid liquid (cesspool liquid), and after this more brandy was given to him. In a few hours the coma had partially disappeared, but there was a strong tendency to sleep. The breathing was still laboured and oppressed, and he died twenty-four hours after the accident.

POISONING BY ARSENIURETTED HYDROGEN.

Source and Method of Occurrence.—The gas is not used commercially by itself, but arises in large quantities sometimes in chemical works. All recorded cases are accidental. Dixon Mann in the *B. M. J.*, 1, 1896, p. 1332, records five cases, two of which were fatal, and at Accrington in August, 1900, ten cases occurred (*Lancet*, 1, 1901, p. 392). The latter are thus reported by Dr. J. S. Clayton:—

"The process in which the men were engaged was the manufacture of zinc chloride from crude zinc oxide and hydrochloric acid. The zinc oxide was a waste

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material obtained from galvanising iron, and was, in fact, a galvaniser's refuse. The HCl was made on the premises, and admittedly contained arsenic. Unfortunately the firm made no quantitative analysis of these crude materials, but their chemist informed me that a sort of examination was made of both, as is their usual custom, sufficient to show them that less than 0·1 per cent. of As was found in the HCl, and much less than that in the Zn, so little, in fact, as to make the quantity impossible to determine. They also stated that so far as they themselves knew no other case of AsH_3 poisoning had occurred during the twenty years that this ZnCl process had been going on. That other cases have from time to time occurred is however quite certain, very decided information on this point being obtainable from the medical practitioners in the district, though of a less intense character and only in isolated cases.

"On this occasion it appears that the men, for some reason, were eager to get through a certain amount of work by noon, and two or three extra hands were taken on. The vat was kept well going, and more fumes than usual may have been evolved. The day was warm and unusually sultry. The fumes could not get away, and as the crude zinc oxide probably had mixed with it a small quantity of zinc carbonate, from which CO_2 would be evolved, the tendency of the gas would be downward, AsH_3 itself being heavier than air. In addition to this tendency, there would undoubtedly be the powerful indraught exerted by the furnace through the open door. Instead of this free access to the air being a security, on this occasion it constituted a danger. As a matter of fact, the men working nearest to the vat on the platform, and furthest from the well, suffered least, those down below in the well the most. Of those on the platform there were three. One was severely poisoned, one slightly, and the third escaped entirely.

"With respect to the remainder, four men were engaged shovelling zinc oxide from a cart on to the ground area, and were at no time within ten yards of the vat. All of these suffered more or less severely, and three others were occupied in loading barrows from this and conveying it up the gangway to the vicinity of the vat. These also were poisoned severely, one with a fatal termination on the seventh day.

"**Symptoms.**—The symptoms in the ten cases here referred to were characteristic throughout, with the exception of one man who appeared to have absorbed a very small quantity of the gas, and who was correspondingly slightly affected. It is only necessary to quote one case as typical of the series, that of the foreman, who was engaged in emptying bags into the vat, and who was the most seriously affected of those at the vat. He was a robust, powerful man, and had been engaged at this particular work for sixteen years. If there can be such a thing as immunity from AsH_3 he should have afforded an example. He had been at work there all the morning, and left his work at 2 p.m. At 2.30 he felt sick, nauseated, and depressed, with a hot, burning pain from his throat to his stomach, and with an intense thirst. This was soon followed by violent vomiting, at first of food, then of everything as soon as swallowed, even iced water. This again was followed by an equally severe diarrhœa; the discharges were at first loose fæcal matter, then rice-watery, and finally contained blood. Added to this, there was hæmoglobinuria and a rapidly developing jaundice, which within twenty-four hours assumed an intense coppery hue. As is usual in these cases, and without any knowledge of the surrounding circumstances and the obvious cause, a diagnosis of cholera would have been pardonable within the first twelve hours. The whole effect was that of an irritant poison taken by the mouth, being evidence that the arsenic in the gaseous state was absorbed by the blood direct from the lungs, and in its passage through the walls of the stomach was separated there and acting directly. Doubtless also some may have been swallowed in the saliva. The feeling of depression deepened into extreme prostration, the features were shrunk and cyanosed, the pulse thready, and the voice lost. These severe symptoms lasted with gradually diminishing severity for several days. The feeling of prostration, the anæmia, the almost pale green colour of the skin which supervened on the disappearance of the jaundice, lasted for several weeks longer, and it was only after the lapse of five weeks that he was able to return to work.

"In the one fatal case the symptoms showed no variation from the above, excepting that there was no tendency to recovery. Towards the close there was suppression of urine, and after thirty-six hours of complete unconsciousness, he died on the seventh day.

"In all of these cases there was jaundice. In eight of them it was intense.

In two only could it be described as slight. In nine also there was hæmaturia. Intense thirst and a burning pain in the chest characterised the onset and earlier stages of all the cases. Diarrhœa was troublesome in five, and all the cases, with the single exception referred to, suffered from profound anæmia in the later stages of the disease. The effect on the nervous system was more or less severe in nine. In six of these the prostration and collapse of the earlier stage was very severe.

"One man who was engaged with these ten, and who was on the platform nearly the whole time, escaped without any symptoms whatever, and the varying degrees in which they were affected would seem to indicate that individual susceptibility played an important part. The man who died could not have been described before this as a good life. He had been a heavy drinker, and the effects of chronic alcoholism no doubt militated against any tendency to recovery."

On these cases Dr. Clayton also made the following comments:—

"The obvious deduction from this incident is that of Dr. Dixon Mann:—

"'It ought to be a standing rule at all works where any operations are performed in which hydrogen is largely produced from crude materials that the process should be carried out in a closed vat, furnished with a sufficiently wide earthenware tube, so as to conduct the gases evolved directly into the tall chimney of the works.'

"Hitherto the recorded cases of arsenetted hydrogen poisoning have been comparatively few in number. In a very complete monograph on the subject by Drs. Dixon Mann and Gray Clegg (*Manch. Med. Chron.*, 1895), a list of forty-nine cases is recorded which the authors believe includes all cases published up to that time. I am informed by Dr. Legge that the only cases reported to the Home Office since then, and the only cases of which I have obtained information as occurring in this country, have been two fatal cases and one non-fatal case which occurred at a Weldon chlorine still at Irvine, Ayrshire, and one at a zinc chloride work in Blackburn. These, together with the ten cases here recorded, would bring the total to sixty-three."

Analysis.—If required must be that of arsenic, *q.v.*

POISONING BY UNKNOWN GAS FROM DYE WORKS.

The editor thinks the following case of sufficient importance to be recorded, but the evidence is obviously incomplete. It might be that arseniuretted hydrogen was the cause of death. The case is reported from Withington, Manchester, by Dr. Saul, in the *B. M. J.*, 1, 1904, p. 487.

"A man, aged thirty-seven years, came to my surgery about 6 p.m. on Christmas Eve complaining of faintness and nausea. He said that about an hour previously, while preparing a dye mixture, he was suddenly seized with nausea, followed by repeated vomiting and prostration. He did not get better when out in the open air, so he came for advice. The man was of sturdy build, but looked haggard; he was much agitated, and in dread of death.

"The first thing that struck me was the changed appearance of his skin. His face was covered with a reddish rash, the mucous membrane of his mouth had a brownish discoloration, and there were two rounded black spots on the cheek. The rash extended to the general surface of the body, and scattered over the trunk, upper arms, and thighs were groups of dark spots similar in character to those on the face. They were each a little smaller in size than a shilling piece, quite round, very black in the centre, and shading off to a grey towards the circumference. They were mostly in groups of five, arranged lengthwise, but were each quite distinct, not raised, and not disappearing on pressure.

"The pulse was 90 per minute; the temperature 98·8°; heart and respiration were normal. He was perfectly clear in all his statements. His wife, who accompanied him, told me that he was temperate and careful as to his food and habits. I could not examine the contents of the stomach, as the repeated vomiting had emptied it, but was told that he had not taken anything injurious by the mouth in the shape of food or drink. His pupils reacted normally to light. The knee-jerk was slightly increased, otherwise nothing abnormal was to be noticed.

"The sample of urine given me was normal. The man said he was sure he was not going to live, as some years ago a similar case happened at their works which ended fatally.

"It was evident that the attack was caused by the inhalation of some poison which emanated from the dye mixture the man prepared, but I could not make sure what particular poison it could have been.

"The treatment ordered was rest in bed and an aperient of magnesium sulphate followed by bismuth. The patient improved rapidly. The rash became fainter on the following day, and he was able to retain fluid nourishment without any nausea. On the third day from the time of the onset the red rash had disappeared, and all that remained of the black spots were a few greyish crescentic lines. The patient felt fairly well, the only anxious point being occasional periods of drowsiness and very sluggish reaction of the pupil to light. The next two days he continued to improve, and seemed almost well, but he died quite suddenly on the sixth day from the onset of the symptoms.

"At the inquest no fresh light was thrown on the actual cause of death. It was concluded that the man died of blood poisoning caused by the inhaling of some noxious substance which affected the blood directly and led to heart failure. What kind of substance it was we failed to ascertain. No aniline dyes were used."

Caisson Disease, or Poisoning by Compressed Air.

Source and Method of Occurrence.—The development of engineering skill has led to this trouble being added to a list of diseases. The workmen toil in immense iron cylinders, which are filled with ordinary air at a very great pressure for the purpose of keeping out the water (*vide* Oliver's address on the subject, *Lancet*, 1, 1909, p. 297).

The disease can hardly, perhaps, be called poisoning, and yet there is no other place for introducing the subject into a work on medical jurisprudence.

The cases are obviously all accidental, and the only reason for discussing it is that claims for compensation for injuries thus sustained may be brought into court, and medical evidence may be required.

The literature of the subject is now rather extensive, dating back even to 1854, but becoming voluminous by 1880 or so (*vide* Clifford Allbutt's "Syst. of Med.," vol. 7, p. 43, article by Andrew Smith).

Toxicity and Fatal Dose.—The accidents all depend upon a too rapid transition from a high atmospheric pressure to a low one. This is the essential cause, whatever may be the exact internal pathology of the process. With regard to this latter point, opinions are still divided, the two main views being (a) that the sudden diminution in pressure leads to air emboli from the excessive disengagement of gas dissolved in the blood at high pressure; (b) that the pressure produces changes in the blood distribution throughout the body (Allbutt, *l.c.*). Dr. Wainwright (*Lancet*, 2, 1900, p. 1792) draws attention to the fact that there are two separate groups of symptoms: those which occur on entering and those on leaving the high pressure conditions. It is certain that the former depend on the rather sudden change in pressure on the middle ear, and it is quite established that the latter, at any rate in any severe form, depend on (a).

Whatever be the truth of these hypotheses, the fact remains that a very considerable number of deaths have occurred from caisson disease. In the last few years nearly 100 men have lost their lives from this complaint in the United States (*Lancet*, 1, 1904, p. 341). It seems as though it were inevitable that *some* workmen should suffer in all cases where high air pressure work is carried on (*B. M. J.*, 2, 1903, p. 936).

Duration.—Varies exceedingly. Paralysis may be quite temporary or be protracted for weeks or months, and becomes even permanent when it depends on destruction of nerve strands in the brain or spinal cord. Death occurs only in cases that are severe from the first, and, except when due to a secondary lesion, usually takes place within three or four days (Smith, *l.c.*). There is frequently delay in the onset of symptoms, the men not complaining till some hours after leaving work.

Symptoms.—Pain often very severe in one or more of the extremities or epigastrium ; this may or may not be associated with nausea and vomiting. Headache, vertigo, and unconsciousness are also common, and paralysis more or less extensive and complete. In rare cases sudden death, almost without symptoms, occurs (*vide* Smith, *l.c.*).

It is easy to see how the paralysis will vary according to the severity and the situation of the local damage produced by blocking of small bloodvessels. Indeed, the sudden deaths are equally easily explained by a severe brain lesion in one of the vital centres.

Treatment.—The treatment is essentially prophylactic, *i.e.*, to prevent the trouble by graduating the return to normal pressures, but Dr. Wainwright (*Lancet*, 2, 1900, p. 1797) advocates a return to high pressure if and as soon as the patient complains of any trouble on reducing the pressure. As a practical rule Wainwright says, "I think it is of advantage not to reduce the pressure faster than at the rate of one pound in three minutes." Dr. Smith speaks of ergot as useful. Hot baths with friction are useful at times, as also are sinapisms to the epigastrium and hot alcoholic drinks.

Dr. Leonard Hill has done a great deal of experimental work on the subject on pigs, and also on himself and volunteers, and has conclusively established the fact that symptoms can be absolutely avoided by gradual decompression. He thinks that Wainwright's formula of a pound in three minutes is unnecessarily slow and almost impracticable, and agrees with the editor, who suggested to one firm that a pound a minute is safe and workable. He also objects to the alternative method of decompression by more suddenly established stages, believing this method to be dangerous, the only point in its favour being the ease with which it can be managed and controlled by the man in charge of the air-pump apparatus.

Post-mortem Appearances.—Inasmuch as any changes that may be found are essentially due to air emboli in small bloodvessels, it is at once obvious (1) that the locality of any damage is quite a matter of accident, depending on what small vessel became plugged ; (2) that the damage must consist either of congestion of a part by filling from non-blocked vessels or of an infiltration of the tissues with blood should a small vessel give way under the pressure of the evolved gas.

This easily explains the softening of the spinal cord which was found in each of a series of ten fatal cases (Smith, *l.c.*).

Cases.—The Baker Street and Waterloo railways construction cases (*Lancet*, 2, 1900, 1792); the Manhattan Bridge cases (*Lancet*, 1, 1904, p. 341).

Poisoning by Carbon Disulphide.

Source and Method of Occurrence.—The substance is used freely in indiarubber manufacture and also in chemical laboratories as a solvent. The editor is unable to find any report of a case of poisoning by the liquid, but the fumes give rise to symptoms of a more or less unpleasant character. The following is taken from the *Lancet*, 2, 1896, p. 61:—

> "Dr. Stadelmann, physician to the City Hospital, recently drew the attention of the Verein fur Innere Medicin to certain peculiar symptoms observed in workmen employed in india-rubber factories, and he showed three patients who, after having worked for some weeks in those factories, were seized with giddiness, headache, tremors, drowsiness, loss of energy, and gradual impairment of vision. One of them, a man aged twenty-eight years, complained of xanthopsy, and objects moving in the street appeared to him as if seen through a cloud; he also had painful contractions of the muscles and an increasing difficulty in walking or even in standing. Another patient suffered from stammering and fear of walking in the dark, and a further remarkable symptom was anæsthesia of certain portions of the skin. All these phenomena were due to carbon disulphide liberated in the factories, and they are quite characteristic, although only a small number of such cases has been reported up to the present time. Some patients declared that their food had a sulphurous taste, and in grave cases insanity ensued. Preventive measures had obviously been neglected, and Dr. Stadelmann thinks special regulations very necessary for india-rubber factories. Workmen showing the symptoms above described ought to be at once removed from the unwholesome atmosphere."

Symptoms.—Delpech has described with great elaboration the results caused by the inhalation of the vapours of the disulphide in caoutchouc factories ("Nouv. Recherch. sur l'Intoxic. Spec. qui determine le Sulf. de Charbon," Paris, 1860). The results rarely ensue, except in close, ill-ventilated establishments. He states that in these chronic cases there is intense oppressive headache, extending from the bridge of the nose to the temples, giddiness, and that on going into an uncontaminated atmosphere a feeling of intoxication is experienced. Sometimes there is a period of excitement; but in all cases there is at a later stage dulness, apathy, and often partial paralysis of speech. Sight and hearing are affected. There is great loss of muscular power, and anæsthesia. Cramps and fibrillary constrictions of various muscles are rarely absent. The sexual feeling, at first increased, is eventually completely lost. A number of the workpeople suffer from vomiting, colic, and alternate constipation and vomiting. Flatus, having the odour of the disulphide, may be eructed and passed by the rectum; and the urine also not infrequently smells of the poison.

Bernhardt has observed similar cases (Husemann's *Jahresber.*, 1872, p. 495).

Rendu ("Sem. Méd.," November 11th, 1891) reports a case of poisoning by bisulphide of carbon. The patient was a girl, aged fifteen, who for about a year had been employed in vulcanising caoutchouc balls. She had for some time experienced frontal pain and heaviness of the head, but till shortly before admission she had had no other troubles. About a month before entry the pains became more violent, and were soon accompanied by a painful contraction of the masseter muscles, then by stiffness of the neck and vertebral column; finally the legs and arms were also attacked. It was found that the contractions, though generalised, were nowhere complete, but the contraction of the masseters prevented the jaws from being separated. It was probably this latter fact which had provoked a severe attack of ulcerative stomatitis, due to accumulation of tartar between the teeth. The tendon reflexes, too, were found to be slightly exaggerated. The explanation of this case seems to have been that the girl had been exposed all day to an atmosphere laden with the vapour of bisulphide of carbon; the initial symptoms—headache and heaviness of the head—are undoubtedly those associated with poisoning by this drug. The later symptoms were probably due to the same cause, and, judging from the order of their appearance, were the result of a further action on the central nervous system, first on the medulla and cervical cord and eventually on the whole spinal tract. It may be suggested that the affection was in a measure hysterical, but against this view there are the facts (1) that there was no history, either actual or hereditary, of hysteria; (2) that the contractions were incomplete and generalised, the limbs being the least affected, there being also no disturbance of sensation; (3) that the usual stigmata of hysteria were entirely absent. Beyond the contraction there was no nervous phenomenon. Other cases of poisoning by carbon bisulphide have been recorded, notably by Delpech, but none of them showed such a firm contraction of the jaws, and in them the contractions always passed off after a few days (*B. M. J.*, 1891, 2, Epit., p. 162). The editor has met with one or two cases from the Silvertown rubber works, in which the symptoms closely resembled hysterical or neurasthenic conditions, *i.e.*, mixed complaints of subjective nervous phenomena with no signs of organic nerve disease.

Analysis.—The odour and inflammability of this liquid are sufficient to identify it even in the smallest quantity. The liquid also is well known as a solvent for iodine and indiarubber.

Poisoning by Ferro-silicon.

The following paragraph is taken from the *Lancet*, 1, 1909, p. 416:—

> The January number of the *Journal of the Royal Institute of Public Health* contains an interesting report on the gaseous emanations of ferro-silicon founded upon the recent deaths of Russian emigrants from inhaling the gases given off by this substance which was part of the cargo on board ship. Biological experiments proved that ferro-silicon when moist readily evolves gases which are very poisonous. Ferro-silicon is described as a coarse metallic powder which is manufactured by heating a mixture of iron ore, quartz, coke, and lime in an electric furnace, and is used by steel makers as a convenient method of contributing silicon to certain grades of steel. As long as it is dry ferro-silicon appears to be harmless, but when moistened it evolves chiefly phosphoretted hydrogen and possibly some arseniuretted hydrogen and acetylene by virtue of the action of water on the phosphides, arsenides, and carbides present. Phosphoretted hydrogen is stated to be so poisonous that air containing 0·02 per cent. of the gas is fatal to

small animals within half an hour. The inquiry is being continued under the direction of Professor William R. Smith, who receives the assistance of Dr. Hermann Dodd in regard to pathological questions and of Dr. Charles E. Harris in regard to chemical questions.

In January, 1910, the Local Government Board published a supplement to the above report (Wyman, Fetter Lane, price 1*s.* 11*d.*). It proves that phosphoretted hydrogen is the toxic agent, and contains conclusions as to the safe carriage of the material. *Vide* also *Trans. Med. Leg. Soc.* 1909—10, paper by Dr. H. Hake.

Group 3.—THE NON-METALLIC ELEMENTS.

Phosphorus stands here as the most poisonous representative of the group, and yet it has much more likeness to arsenic and antimony in its ultimate action than it has to any of the members of its own group. Chlorine is an irritating and irrespirable gas, with a local action; and fluorine is practically unknown out of combination. Iodine is a powerful irritant to the stomach, if not a corrosive, while sulphur may be eaten by the teaspoonful with practical impunity if not with benefit. Carbon is an innocuous solid; hydrogen and nitrogen are merely irrespirable gases, while oxygen is the very breath of life; and yet from these four non-metallic elements are formed some of the most powerful poisons known to science. The alkaloids, for example, are many of them simply such compounds, and hydrocyanic acid is itself a very simple compound of three of them.

So far as toxicology is concerned, phosphorus and iodine are the most important, poisoning by the others being rare.

Poisoning by Phosphorus (P).

Source and Method of Occurrence.—Phosphorus is manu- tured for many purposes, matches, rat-poisons, etc., etc.

Poisoning with phosphorus is not very infrequent in this country; and on the Continent of Europe this poison is often selected for the purposes of suicide or murder. In England and Wales, in the year 1891, there were nineteen deaths from phosphorus poisoning, and ten in 1901, of which four were suicidal, the others accidental. In France, within a period of six years, there were 103 cases of poisoning with phosphorus which gave rise to medico-legal inquiry. The tips of lucifer matches and rat-pastes are the most common sources whence this poison is obtained.

Phosphorus is not often used in this country in attempts at murder. The smell and taste, as well as its luminosity, commonly reveal its presence.

At the Norwich Autumn Ass., 1871 (*R.* v. *Fisher*), a girl of eighteen was convicted of an attempt to poison a family. She put a vermin compound of phosphorus into a teapot containing tea; when hot water was poured into it, the smell at once led to suspicion. Phosphorus, which had been taken from a pot of vermin-killer carelessly left about, was found in the teapot. The girl was convicted.

Casper describes a case in which the luminous appearance of the poisoned food led to a suspicion of poisoning with phosphorus, and this was subsequently proved.

A woman put a preparation of phosphorus into some soup, and gave it to her husband. He ate it in a dark room in the presence of some friends, and they noticed that the liquid as he stirred it was luminous (*Vierteljahrsschr. f. Gerichtl. Med.*, July, 1864). In this way a person may be warned and a life saved (see "Ann. d'Hyg.," 1870, 2, 203).

Phosphorus is usually taken in this country for suicidal purposes in the form of rat-paste, a compound of yellow phosphorus, fat, sugar, and flour, coloured with Prussian blue. Sir Thos. Stevenson has found a sixpenny pot of this paste to weigh 157 grains, and to contain eight grains of phosphorus. In France and Germany the heads of matches are commonly used for the same purpose; and 80 or 100 grains are a fatal dose, containing about a grain of phosphorus. The official dose of phosphorus is one one-hundredth to one-twentieth grain.

Red or Allotropic Phosphorus.—The remarkable substance, known under the name of allotropic phosphorus, is not possessed of poisonous properties. This fact, long since announced by Liebig ("Letters on Chemistry," p. 165), has been confirmed by all subsequent experience. It has been given to animals in doses of thirty grains without causing symptoms of poisoning. This kind of phosphorus, by reason of its being generally in a fine powder, is in a state more favourable for acting as a poison than common phosphorus; and yet it is inert. Bussy in 1850, and De Vrij in 1851, proved that a dog might take with impunity thirty grains.

A woman, æt. 26, swallowed the composition scraped from a number of lucifer matches: it turned out that these were made with red phosphorus. She suffered no inconvenience. She procured other matches of yellow phosphorus, took a decoction of them in coffee, and died from the effects.

Toxicity and Fatal Dose.—That phosphorus is a powerful poison, is proved by two cases quoted by Christison. In one, death was caused by a grain and a half in twelve days; in the other, by two grains in about eight days. One to two grains is a fatal dose. It is probable that it operates as a poison only by becoming converted into phosphorous oxide; but although this conversion takes place, it is possible that phosphorus may pass directly into the blood, since the urine voided during life has been observed to be luminous: hence it is itself probably a blood-poison. Organic compounds containing phosphorus (phosphines) are found in the urine in cases of phosphorus poisoning. The production of phosphorous acid, by its oxidation, may account for the erosions met with in the stomach and bowels.

Chevallier refers to a case in which a dose of 2·3 grains proved fatal, and two other cases in each of which a dose of 4·6 grains destroyed life. The same writer quotes, on the authority of Lobel, the case of a lunatic who died from a dose of **one-eighth of a grain** ("Ann. d'Hyg.," 1857, 1, 422). This is the smallest fatal dose for an adult which we have met with.

A woman, æt. 52, took in divided doses, in four days, about six centigrammes, or less than *one grain*, of phosphorus dissolved. The largest dose taken at once, *i.e.*, on the fourth day, is stated to have been three centigrammes, or nearly half a grain. Symptoms of pain and irritation appeared, and the patient died in three days. The gullet, stomach, and small intestines were found much inflamed ("Toxicologie," vol. 1, p. 87).

When the phosphorus is dissolved in any liquid, or when it is finely divided, as in phosphorus-paste or in lucifer matches, its action is then more powerful, as it is in a state well fitted for absorption. Kessler has recorded a case in which an infant seven weeks old was destroyed in four hours from swallowing the heads of six or seven matches, containing about one-eighth of a grain of phosphorus (*Vierteljahrsschr. f. Gerichtl. Med.*, N.F. IV. p. 271). Sonnenschein refers to the case of an infant of five weeks who died from the effects of a single match-head, containing possibly not more than one-hundredth of a grain of the poison.

In 1882 a man, æt. 32, was admitted into Guy's Hospital, who had taken half a sixpenny pot of phosphorus paste in whisky at 3 p.m. He had vomited before his admission at 5.30 p.m. An emetic was administered on admission, which acted immediately. The vomit emitted white fumes, and smelt strongly of phosphorus. He was pale, cold, depressed, and showed signs of alcoholism. His breath had a slight alliaceous odour. There was severe epigastric pain, with a burning sensation in the throat and gullet. The emetic was repeated; and he vomited at intervals till 2 p.m. The last vomit had no phosphoric odour. Large doses of carbonate of magnesium were given in mucilage and milk. He felt relieved of the pain in the epigastrium, though there was some tenderness on pressure. Twenty-four hours after the administration of the poison he began to take oil of turpentine, beginning with 15-minim doses; and this was increased subsequently to 30 minims. On the third day the liver began to enlarge, and on the fourth day there was decided jaundice. The liver continued to increase in size till the sixth day, when it began to decrease. He suffered from headache and drowsiness. When the liver began to decrease in size, the oil of turpentine was discontinued. The patient made a good recovery. At one time the liver dulness extended to the upper border of the fourth rib on both sides, extending to the left beyond a vertical line from the left nipple; and downwards it reached nearly the navel.

The dose taken was probably four grains.

Duration.—Symptoms are commonly delayed for from a quarter of an hour to some three or four hours and the total duration varies greatly, from a few hours to two weeks or more. In a case related by Orfila death took place in four hours. In another case, also related by him, death occurred only after seventeen days. Habershon quotes a case which is said to have proved fatal in **half an hour** ("Med.-Chir. Trans.," 1867, vol. 50). This is the shortest period recorded. In general, several days elapse before a fatal result occurs, and during this time the patient undergoes much suffering. This was observed in a young woman who swallowed a quantity of phosphorus paste intended for poisoning rats. She did not die until the fifth day. This is a common period (*Jour. de Chim. Méd.*, 1845, p. 580). In two cases of acute poisoning with phosphorus communicated by Moore, one proved fatal in seventy-two, and the other in eighty-eight hours. In a case which occurred to Anderson, a child, aged one year and eight months, had sucked the heads off about twenty phosphorus matches before detection. No symptoms appeared until the second day, when the child was drowsy and slept for twenty hours. On the fourth day it vomited, the skin was hot, the tongue dry, there was great thirst, with a quick pulse and cold extremities. On the sixth day there was much vomiting of a matter like coffee-grounds (altered blood). There was great pain in the stomach—the child became unconscious and gradually sank, dying on the seventh day after taking the poison. There was no purging, but the motions were passed involuntarily, and contained coagulated blood. An alliaceous odour was perceived in the breath during the progress of the case, and the body had a yellowish (icteric) tint.

Modern research has with tolerable completeness explained these great discrepancies in the duration of a case of poisoning by phosphorus. In a case that ends fatally within a few hours the result is due in all probability to shock and exhaustion, possibly also assisted by slight absorption of the poison with an acute killing effect upon the heart. In the cases that end after several days, the fatal event is due to the power which phosphorus is now well known to possess of inducing degenerative changes in gland and muscle cells, changes primarily and chiefly of a fatty character, but these changes take some little time to reach a fatal extent. They are found typically and visible to the naked eye in the liver and heart, but can also be demonstrated in the stomach, kidneys, and muscular tissues generally; they fully explain the hæmorrhages in organs and tissues, for they are found in the muscular coats of the arterioles too. The exact metabolic changes by which this result is produced will be found discussed in Dixon Mann, "For. Med.," 4th ed.

Symptoms.—In the first instance the patient experiences a disagreeable taste, resembling that of garlic, peculiar to this poison. An alliaceous or garlic-like odour may also be perceived in the breath. There is pain and oppression in the region of the stomach, malaise, eructation of phosphoric vapours, having a garlicky odour; and these may be luminous in the dark. Vomiting is sometimes frequent and violent; in other cases quiet and at longer intervals. The abdomen is distended. Purging is not common. The vomited matters are coffee-coloured, or yellow and bilious, and may be luminous. There is intense thirst. The symptoms may increase in severity, ending in death from collapse in the course of a few hours—four to eight in the worst cases.

Nevertheless, in the majority of cases the progress to a fatal termination is slower and more insidious. The irritant symptoms in a great measure subside, and though the pulse is feeble, and there is a certain amount of malaise, the patient may to a casual observer appear to be in almost a normal state of health. But after the lapse of three or four days, jaundice sets in and rapidly increases, there is great prostration of strength, the abdomen becomes distended, the liver is observed to be greatly enlarged, and vomiting of altered blood may come on with intense thirst; the skin is cold, and probably scattered hæmorrhages appear beneath it; the pulse becomes feeble, rapid, and perhaps imperceptible at the wrist; the urine is scanty and high-coloured, and contains casts from the kidneys. The fæces, previously suppressed, are now more abundant, and contain blood. Coma sets in, with jactitation of the limbs, or muscular twitchings; and the patient succumbs generally about five or six days after the administration of the poison.

F. A. Elkins has described very fully the symptoms exhibited in a case of phosphorus poisoning by matches; and Middlemas made an elaborate microscopical examination of the tissues in the same case. Briefly stated, the symptoms and the physical signs were, in the order of their appearance:—*Alimentary System.*—Nausea; retching; vomiting; "indigestion feeling"; disagreeable taste of "rotten eggs" and "rotten greens"; discomfort, then pain, and latterly spasmodic pain, in the hepatic region; increased hepatic dulness; jaundice; intense thirst. *Circulatory System.*—Increase of pulse rate; compressibility, and latterly irregularity and threadiness of pulse; palpitations; cardiac sounds indistinct and distant; cardiac failure and temporary stoppage of radial pulse; faintness; lividity; coldness of extremities. *Respiratory System.*—Yawning; irregular respiration approaching the Cheyne-Stokes type. *Urinary System.*—Urine scanty, high-coloured, of high specific gravity, with traces of albumen and bile, and having a deposit of urates, mucus, fatty casts, and *débris*, and leucin and tyrosin may be found in it. *Nervous System.*—Mental symptoms: listlessness; drowsiness; restlessness; mental confusion; inability to understand what was said; inability to answer questions readily or correctly; inability to recognise friends; semi-consciousness; semi-delirium; delirium; fits of great restlessness and violence; constant use of the word "yellow" when delirious; maniacal expression and behaviour; unconsciousness; coma. Sensory symptoms: "rheumatic pains"; blindness (?). Motor symptoms: thick and drunken-like speech; pupils fixed and dilated; external strabismus on left eye. The pathological interest of this case lies in the changes in the nerve cells of the cortex of the brain. The production of fatty degeneration in them shows that the tissues of the nervous system are not exempt from the powerful action in this direction which phosphorus possesses. The occurrence of the change in so many organs and tissues of the body would point to some fundamental alteration in the processes of metabolism which phosphorus has the power of bringing about (*B. M. J.*, 1891, 2, p. 1302).

It may thus be said that there are four stages in phosphorus poisoning.

1. A latent interval between the swallowing of the poison and the onset of any symptoms varying between a quarter of an hour and two or three hours.
2. A period of irritant symptoms, vomiting and pain lasting several hours to a day or two, and ending either in death; or
3. A second latent period in which health seems to be restored and which may last for from about five or six days, the common period, up to as long as six weeks, in a case recorded by West (*Lancet*, 1, 1893, p. 245).
4. A period of symptoms closely resembling if not identical with those of acute yellow atrophy of the liver.

It will be perceived that, in reference to (1) the delay in the appearance of symptoms, (2) their similarity (taken as a whole) to disease, and (3) the time at which death occurs, cases of phosphorus poisoning might easily throw a practitioner off his guard when debating his diagnosis.

Treatment.—The principles of treatment are, firstly, to evacuate from the stomach the swallowed phosphorus, and, secondly, to render harmless, if possible, that which is inevitably left behind.

For the first purpose the stomach pump should be used and the viscus thoroughly washed out, and this is the only point on which authorities are agreed. It is suggested that an emetic of copper sulphate (two or three grains) should be given, but Luff says ("For. Med.," 1, p. 139) that this should be avoided, as severe gastro-enteritis is liable to follow. The editor has not had sufficient experience to decide the matter positively in one direction or the other.

For the second purpose all authorities are agreed that no oil nor fat should be given, for these dissolve the phosphorus, and therefore promote its absorption: as to what should be given and the reasons for the procedure there is diversity of opinion. Oxidised oil of turpentine and sanitas have both been recommended, but apparently on very doubtful grounds. Luff thus comments on them:—

> The administration of old or oxidised oil of turpentine is generally advised, forty minims being given in the form of an emulsion made with mucilage every fifteen minutes for the first hour, and afterwards three or four times a day until the patient is out of danger. The utility of oil of turpentine in cases of phosphorus poisoning has been very much questioned; at one time it was believed that its sole use was on account of the small quantity of peroxide of hydrogen contained in it, the function of which would be to oxidise the free phosphorus to phosphorous or phosphoric acid. From experiments made by Bush (*Lancet*, 1892), of Dorpat, on some of the lower animals, it appears that turpentine has the power of hindering to a certain extent the toxic action of phosphorus, the explanation of its action being that it forms a compound analogous to terebinthino-phosphoric acid, which body is less toxic than the phosphorus contained in it. Peroxide of hydrogen in the form of sanitas (a mixture of turpentine and water oxygenated by the prolonged action of air, and containing peroxide of hydrogen and camphoric acid in large quantities) may be given, in half-drachm doses mixed with water; but it is somewhat slow in its action, and apt to further irritate the already irritated gastric mucous membrane.

Thornton, in the *Therap. Gaz.*, 1893, considers that permanganate of potash is the best antidote. It should be administered well diluted with water (·5 or 1 per cent. solution), and copious drinks of the diluted solution should be given before the poison has had time to become absorbed.

Further treatment must be purely symptomatic (*vide* pp. 334 *et seq.*).

Post-mortem Appearances.—These vary to some material extent according to whether death takes place within, say, twenty-four hours, or not till after the lapse of four or five days or more. In the former case the stomach and intestines show marks of irritation, inflammation, and ulceration. The stomach has been found much contracted, and its mucous membrane inflamed, occasionally softened and presenting purple or violet-coloured spots. Inflammation of the stomach and bowels may be a result of the action of phosphorus. A man, æt. 50, took a quantity of phosphorus paste used for destroying vermin. He was seen in his usual health at twelve o'clock at noon, and was found dead in a field the following morning. On inspection, it was observed that there was great muscular rigidity. The heart was flaccid and nearly empty. The mucous membrane of the stomach, gullet, and small intestines was very red, and there were patches in which the membrane was destroyed. On opening the stomach a white vapour escaped, accompanied by a strong smell of phosphorus. This organ contained a tablespoonful of a viscid greenish matter, from which particles of phosphorus, with some Prussian blue (used as a colouring for the poison), subsided on standing (*Lancet*, 1857, 1, p. 600; see also a case by Kessler, Horn's *Vierteljahrsschr.*, 1866, 1, 271). In a case examined by Herapath, he found, besides inflammation of the stomach, the mucous membrane raised in small bladders or vesications. This was probably a change produced by putrefaction, as the body was not examined until twenty-three days after death. Such an appearance is frequently seen in the inspections of putrefied bodies, and has not been observed in cases of recent poisoning by phosphorus. Schuchardt describes, among the appearances, fluidity of the blood, which is of a dark colour, and does not become red on exposure to the air.

In the cases with a longer duration the most remarkable appearance commonly met with is a fatty change in the liver and other soft organs. Ecchymoses are often found beneath the skin and on the surface of various organs.

In the case of one female, who died after the lapse of a week, there was no inflammation, ulceration, nor softening of the mouth, gullet, stomach, nor small intestines. There was a red patch in the cæcum and another in the colon (the large intestines). The contents of the stomach and intestines had a coffee-ground colour, like the liquid found in hæmatemesis (vomiting of blood). There were bloody effusions in the chest and abdomen. The viscera, and even the flesh of animals recently poisoned by phosphorus, have the odour of garlic, and appear luminous in the dark (Galtier, "Toxicologie," vol. 1, p. 184). In one case which the author examined in 1867, that of a girl, æt. 13, who died on the sixth day after taking phosphorus paste beaten up with egg, there were numerous ecchymosed patches in the cellular tissues of the skin of the abdomen over the rectus muscle; these were also seen on the chest and on the diaphragm. The stomach contained a dark-coloured thick fluid like altered blood; the coats were not inflamed; the surface of the inner coat was covered with a brownish-coloured mucus which had no odour of phosphorus. At the greater curvature the surface was dotted over with numerous small dark particles, consisting of coagula of altered blood adhering to the membrane, but easily removed from it. The contents of the stomach owed their colour to these little masses of blood being diffused through them. The duodenum contained a similar liquid. The intestines presented no abnormal appearance. The liver was in an advanced state of fatty degeneration.

In a case recorded by Habershon ("Med.-Chir. Trans.," 1867, vol. 50), in which a woman died on the fifth day, the symptoms and appearances were similar to those above described. The phosphorus was taken in the form of paste, and, as was supposed, in a dose of from three to four grains. There was much ecchymosis in patches in and about the cellular tissue of the abdomen and chest. There was fatty degeneration of the liver and kidneys. The stomach contained a large quantity of fluid, like soot and water, and was covered with a tenacious bloody mucus. There was some congestion of the mucous membrane, and there was much redness with ecchymosis in the small intestines.

Sir Thos. Stevenson has seen decided enlargement of the liver produced within forty-eight hours of the time at which the poison was administered. The liver is usually enlarged, doughy, anæmic, and of a uniform yellow or yellowish-white colour. The acini are distinct. The hepatic cells are loaded with fat. The heart and muscles generally may be soft, yellow, and of defective tenacity. In place of the transverse striæ, innumerable fat globules are seen by the microscope. The glandular epithelial cells of the gastric follicles are filled with fat globules. The cortex of the kidneys is likewise filled with fat globules. (For further information on this subject, see "Die Vergiftungen von D. R. v. Jaksch.," Leipzig, 1910).

In a case that died so short a time as fifty-nine hours after swallowing the poison the heart was found to have undergone fatty degeneration, and it and the aorta exhibited ecchymosed patches. The stomach was considerably injected, and its surface was thickly coated with tenacious mucus. The small intestine was much injected at its commencement, and to a less degree lower down. The liver weighed twenty-six ounces, was yellow, anæmic, and showed extreme fatty degeneration, except in isolated patches. In this case the dose of phosphorus could not be ascertained (Guy's Hosp. Rep., xxii., 1877, p. 449).

Analysis.—If the person has survived several days, it is not likely that any free phosphorus will be found in the stomach nor in its contents. None was found in the contents of the stomach nor in the fatty liver of a girl who died on the sixth day, but the distillation process succeeded with the broken top of a pot which had held the phosphorus paste, although this was empty and had been thrown into a tub of water. In Habershon's case of death on the fifth day, none was found by Sir Thos. Stevenson in the stomach nor in its contents. The phosphorus in these cases is oxidised rapidly, and thus, like other poisons, it may disappear from the body. If a piece of filter-paper imbued with a solution of nitrate of silver be exposed to the vapours or gases evolved from the suspected articles, and be not darkened nor blackened, it may be concluded that no evidence of the presence of uncombined phosphorus will be obtained by other means. Under these circumstances the phosphorus may, according to some authorities, be still discovered as phosphoric acid. Mialhe has given an elaborate report on a case in which the symptoms and appearances were those of phosphorus poisoning, the girl dying on the fifth day. Mitscherlich's process failed to show any free phosphorus. Eight weeks afterwards portions of the viscera were examined by Tardieu and Roussin. They found in the intestines and on the liver groups of small crystals of ammonio-phosphate of magnesium, and in the fluid contents an acid liquid having the properties of phosphoric acid ("Ann. d'Hyg.," 1869, 1, 134). These crystals, it may be observed, are frequently found as a result of decomposition in the stomach or the liver, kidneys and urine, and other organs, without reference to poisoning by phosphorus. As phosphates are found in secretions, which are generally acid, their presence does not prove poisoning by phosphorus, unless the symptoms, appearances, and circumstantial evidence are so strong that chemical evidence is scarcely necessary.

In one case Herapath failed to detect any trace of phosphorus in a body on the twenty-third day after death.

Phosphorus readily undergoes oxidation in the body, and is thus converted into phosphorous and phosphoric acids. Blondlot suggested a process for its detection when this conversion into phosphoric acid had taken place. It depends on a peculiar green colour which the lower oxides of phosphorus give to the flame of nascent hydrogen when burnt (*Jour. de Chim.*, 1862, p. 528; also 1863, p. 581), but as phosphates are constituents of most of the solids and fluids of the body, this mode of testing would hardly be applicable to medico-legal purposes. It requires for medico-legal application materials of absolute purity for procuring hydrogen, as well as a pure atmosphere, and perfect darkness.

When the phosphorus has been scraped from the tops of matches it may be oxidised and lost; as it is usually coloured with vermilion, Prussian blue, or some other colouring matter, these substances may be found in the washed sediment of the contents of the stomach. On the non-discovery of free phosphorus in the body, these colouring matters, if present, serve to indicate the form in which the poison has been taken or administered. The proportion of phosphorus in matches varies. The dry composition may contain as much as one-fourth of its weight. Phosphorus paste is said to contain one-eightieth of its weight of this substance ("Ann. d'Hyg.," 1869, 2, 396). Sir Thos. Stevenson has found it to contain 5¾ per cent. of phosphorus.

The smell which phosphorus imparts to organic substances is characteristic. If the smell is not perceptible, or if concealed by other odours, the liquid supposed to contain the phosphorus may be heated in a flask in the dark, when if phosphorus is present a garlicky odour will be perceived, and the vapours may appear feebly luminous as they are condensed in the air. When phosphorus has been taken in a solid form, the particles may be separated as a sediment, by washing the contents of the stomach in water. These may be melted under water into one mass, either by plunging the tube containing them into hot water, or by pouring hot water upon them in a conical glass. If a portion of the organic liquid is evaporated to dryness in the dark, the particles of phosphorus will be easily recognised by their luminosity, as well as by their combustion when the surface on which the material is spread is further heated. Phosphorus may be separated from many organic matters by digestion with disulphide of carbon. It is thus procured from flour-and-phosphorus paste, or from the residue of the contents of the stomach after washing and decantation. On the spontaneous evaporation of the sulphide, decanted from the organic liquid or solid, the phosphorus may be procured in small globules or beads. These are ignited when touched with a hot wire. A portion of the solution poured upon thin paper, ignites spontaneously when dry, and burns with the well-known flame. The vapours of phosphorus blacken paper moistened with a solution of nitrate of silver. This is known as Scherer's test.

Yellow phosphorus is a solid of waxy consistency, having a peculiar odour and taste resembling garlic. It is the odour and taste which prevent it from being criminally employed as a poison, and render it easy of detection in articles of food. It evolves a white vapour in daylight, and a faint bluish luminosity in the dark. It melts and takes fire at a temperature of 112° C., burning with a bright yellow flame, and producing dense white acid vapours by combustion. It is not soluble in water, but water in which it has been preserved or washed, acquires poisonous properties by reason of the phosphorous and phosphoric acids formed. It is dissolved by alcohol, ether, chloroform, and the oils, but especially by disulphide of carbon.

If the phosphorus is in a state of solution, or is in too small quantity to be dissolved out of the material by disulphide of carbon, its presence may be indicated by distilling the liquid containing it in the dark—the boiling point being raised by the addition of sulphuric acid. The vapour appears luminous as it is condensed in a glass condensing-tube. So delicate is this process of distillation, which was first suggested by Mitscherlich, that in one experiment with the head of a single lucifer-match the luminosity appeared for half an hour in the condensing-tube. Absolute darkness is required for the success of this experiment.

Analysis of the Red Variety.—Red phosphorus is insoluble in all liquids, and by its insolubility in disulphide of carbon it is distinguished and separated from yellow phosphorus. It has no odour nor taste, and is not luminous in the dark, unless it contains yellow phosphorus. In any analysis for phosphorus, we must take care to exclude it by employing disulphide of carbon as a solvent for the common or poisonous form of phosphorus.

Cases.—A female, æt. 20, took several doses of phosphorus paste; the first on the evening of January 11th, 1877. The dose was repeated twice on the 12th. The whole quantity of paste taken was of the size of a large cob-nut, containing about two grains of phosphorus. On the morning of the 13th she retched, and at midday her appetite failed at dinner; and in the evening she vomited. At 10 p.m. on the 14th she was first seen by Tyson, about seventy-two hours after the first and forty-eight hours after the last dose was taken. She had then an excited aspect, and her breath had a phosphoric odour. There was tenderness over the region of the stomach. On the 15th there was slight yellowness of the conjunctivæ of the eyes, slight pain over the stomach, and nausea, but no vomiting. The urine was high-coloured and turbid. On the 16th there was decided jaundice, great thirst, and prostration. There was still a slight garlicky odour of the breath; but the urine and fæces showed no luminosity. There was no obvious enlargement of either the liver or spleen. On the 17th the liver was enlarged; only a very little dark-coloured urine was passed; and there was much epigastric pain and tenderness. In the evening there was slight delirium. From this time she gradually sank, and died on the 18th, nearly a week after the administration of the first dose of the poison. On post-mortem examination the liver was found to be of the usual size; but it had undergone extensive fatty degeneration, as had the heart also. There were no marked appearances in the stomach, which was almost filled with a blackish syrupy liquid (Guy's Hosp. Rep., 1877, p. 452).

In 1876, a woman, and her daughter æt. 5, each drank some phosphorus paste in warm water. The woman was seen four days later apparently in her usual health. Subsequently she sickened, became jaundiced, and died a week after the poison was swallowed. The child exhibited no symptoms till 7 a.m. on the day after taking the poison. She then vomited some slimy material, and her breath had a garlicky odour. In a few hours she was in a state of semi-collapse. Next day she became drowsy, then thirsty, restless, and vomited constantly. There was no jaundice. She died fifty-nine hours after the administration of the poison.

In 1899, Caroline Davis, æt. 63, an inebriate, left drunk 8.30 a.m., and found at 8.30 p.m. (having probably taken red heads of matches), groaning, with abdominal pain, thirsty, and lying on floor. No vomit seen. Admitted into Guy's at 11.45 p.m. She was then collapsed, cold, especially in limbs. No pulse could be felt. Noisy breathing. Pupils medium. Slightly cyanosed. Sweating. Remained unconscious, but reacted to stimulants. Breath smelt of phosphorus. Reflexes present. Treated by stomach-pump, $KMnO_4$, stimulants, artificial respiration, and turps. Died at 1.15 a.m., four and three-quarter hours after she was found. Post-mortem: Slight congestion of gastric mucous membrane, and of upper part of small intestine. No match heads found. Liver fifty-two ounces, pale. Lungs very congested and œdematous (an old bronchitic). Epiglottis and trachea injected. No excoriation of tongue. Other viscera normal, except old thickening of meninges.

In 1904, an inquest was held on a servant girl who, after trying ineffectually to cut her throat, swallowed phosphorus paste.

The following case, reported by Dr. Newry, *Lancet*, 2, 1900, p. 875, has features of considerable interest:—

On August 11th I was called to see a man who was suffering from vomiting and intense burning pain in the stomach and bowels. His history was that on the 7th, when "in drink," he had swallowed three-pennyworth of rat-killer. Immediately after swallowing it he complained of violent pain in the stomach and sickness. He was given salt and hot water, after which he was very sick and vomited freely and expressed himself relieved. On the next day he was a little better, although he felt far from well; he, however, dressed himself and walked about. On the 11th he was taken much worse and I was sent for. When I saw him his temperature was normal, he was quite conscious and coherent, and his pulse was 90. He complained of thirst, constant vomiting, and great pain in the stomach and abdomen. An examination of the vomit proved it to consist wholly of altered blood of a very dark colour. His stools also were dark and pitchy in character. He was given the usual remedies, but they were of no avail, and he quietly sank and died on the following Tuesday, the 14th, having lived exactly a week after swallowing the poison. The vomiting of dark-coloured blood continued up to the time of his death.

A post-mortem examination was made twenty-four hours after death. The weather was very warm, but there were no signs of putrefaction. Very slight rigor mortis, if any, was perceptible. The body presented a most curious and interesting appearance. The whole of the neck in its entire circumference, back, and sides bore the appearance of having been stained in a deep solution of Prussian blue, the colour being most intense and brilliant; it was not mottled but uniformly stained. The arms and legs showed an icteric tinge; their superficial veins looked as though they had been injected with a solution of Prussian blue paint and were most beautifully mapped out. On opening the body the chief points noticed were as follows: The stomach contained half a pint of liquid blood; it was deeply coloured blue; it showed softenings and ulcerations in patches, and it was thickened in other parts. The whole of the intestines showed signs of an irritant poison; they were deeply pigmented with the colour, and the contents were dark and pitchy. The transverse colon was intensely inflamed and the fat of the great omentum showed bright extravasations of blood and was most striking in appearance. The heart, liver, and kidneys showed signs of commencing fatty degeneration. The lungs and the liver were deeply coloured blue. The brain was rather anæmic, soft, and almost diffluent in parts.

And the following as a case of doubtful homicide. It is reported by Sir Chas. Cameron to the *Lancet*, 2, 1896, p. 241:—

On July 3rd, 1896, a female was tried on a charge of murder and acquitted at the County Louth Assizes. The case, which possesses some interest, is briefly as follows. The prisoner's child, a male aged eight months, was seen by a neighbour at 9.30 a.m. on May 6th, and he was then apparently in his usual good health. About 2 p.m. on the same day the child was found "dead and cold." At the post-mortem examination a lucifer match was found in the œsophagus and five lucifer matches in the stomach. The prosecution gave evidence tending to incriminate the mother and contended that the matches must have been forced down the child's throat. There were some inflamed spots on the stomach, which viscus contained only a very small quantity of semi-liquid stuff, chiefly mucus. The wood only of the matches remained, the phosphorus and other chemicals having been dissolved, apparently by the liquids of the stomach. It was not probable that dyspnœa, produced by the match in the œsophagus, caused death, as the face showed no lividity and the child had evidently vomited. The cause of death seemed clearly to be the small amount of phosphorus contained on five matches. Free phosphorus was readily detected in the stomach itself. The child appears to have died an hour or two after swallowing the matches. Blyth quotes results of analysis of matches showing that they contain per 100 from 0·012 to 0·055 gramme of phosphorus. The five matches might therefore have contained from only 0·6 milligramme to 2·75 milligrammes of phosphorus.

CHRONIC PHOSPHORUS POISONING ("PHOSSY JAW").

This deserves separate mention, owing to the particular manner in which it arises—viz., from the repeated inhalation of the fumes of phosphorus by workmen in match manufactories, or other people who are habitually liable to inhale the fumes. After Dec. 31st, 1909, the use of the ordinary phosphorus, from which alone "phossy jaw" arises, was made illegal for the purpose of match-making, and the disease, it is hoped, will become absolutely extinct.

It is but fair to state that phosphorus necrosis is now very rare (not extinct) owing to manufacturers attending to prophylaxis, and also to the use of red phosphorus (safety match).

A case of phosphorus necrosis of the temporal bone is reported by Dr. Würdemann (*B. M. J.*, 2, 1897, p. 1557), and an occasional case happens now and again in the East End of London.

Geo. Wegner has investigated the action of phosphorus on the bones and asserts that its effects are not due to its action after absorption, but to the direct action of the fumes of phosphorous oxide on the bones. When these come into contact with the denuded periosteum or membrane covering the bones, inflammation of this is set up. This is in accordance with the observation that in match-makers those only who have carious teeth suffer from necrosis of the jaw. (See *Lancet*, 1886, 1, p. 671.) For the action of phosphorus on the spinal cord, see *B. M. J.*, 1883, 1, p. 31.

The **symptoms**, as the title implies, are rarely manifested directly the victim begins to work in a factory, but after some days, or perhaps weeks, months, or even years, it may be, he begins to complain of nauseous eructations, frequent vomiting, a sense of heat in the stomach, purging, straining, pains in the joints, wasting, hectic fever, and disease of the stomach, probably associated sooner or later with toothache, for it is by necrosis of the jaw that this form of phosphorus poisoning is especially characterised. There has been also great irritation of the respiratory organs, and bronchitis has frequently shown itself among them.

The toothache is usually sooner or later followed by pain in the jaw, swelling and tenderness of the gums, and formation of abscesses discharging fœtid pus through the cheek, roof of mouth, or even the aural cavity, leaving fistulous openings. The patient acquires a peculiar pasty appearance of the face and puffiness of the cheeks.

Treatment.—This can only be either (1) prophylactic, or (2) purely surgical, removal, *i.e.*, of necrosed bone, etc., or (3) removal of the victim to some other employment. Prophylactic measures consist in (*a*) original and then repeated examination of all the workpeople to see that they have no carious teeth, for this seems to be the special portal of entrance, whatever may be the intimate and ultimate explanation of the action of the phosphorus, to forbid all such to work in the factory until such caries has been thoroughly removed, and the teeth or alveoli after extraction rendered quite sound.

(*b*) The carrying out very strictly of the rules laid down for match and other phosphorus manufactories, including proper ventilation, the vaporisation of turpentine, etc.

Poisoning by Bromine.

Source and Method of Occurrence.—Free uncombined bromine is practically only found in chemical works and laboratories. There are very few cases of poisoning by it on record, a total of five according to Dixon Mann, "For. Med.," 4th ed.

Toxicity and Fatal Dose.—There can be no doubt that bromine is an intense irritant to the stomach or in vapour to the lungs, but no fatal dose can be recorded. It would doubtless very much depend upon the circumstances under which it was taken, having regard to the contents of the stomach.

Symptoms.—So far as known, those of a simple but severe irritant.

Treatment.—Empty the stomach and treat on general principles.

Post-mortem Appearances.—In a case reported by Snell quoted by Dixon Mann there were signs of inflammation of the œsophagus, the stomach and duodenum were much injected, and the mucous membrane of the former apparently tanned. In another case there was found much destruction of the stomach.

Analysis.—Uncombined bromine may be distilled off by heat from organic admixture; if combined it may be set free by saturating the solution with bichromate of potassium and acidulating with H_2SO_4 before distilling. The bromine may be distinguished by its odour, by turning starch paste yellow, by giving a yellowish white precipitate with $AqNo_3$ and a white precipitate with solution of phenol (Mann, *loc. cit.*).

Poisoning by Chlorine.

Source and Method of Occurrence.—Free chlorine (even more strictly than the other halogens) is only found in laboratories and bleaching powder and other chemical works, and consequently poisoning by it is confined to such places, except for a solitary case occurring on board a ship carrying casks of chlorinated lime.

Toxicity and Fatal Dose.—Practically unknown, but, like bromine and iodine, it is undoubtedly very irritating, and would cause fatal symptoms by setting up an acute inflammation, doubtless due in reality to HCl (*q.v.*), formed by the gas combining with the water in the air tubes and stomach.

Symptoms.—Those of suffocative bronchitis or acute gastritis.

Post-mortem Appearances.—Corresponding to the symptoms.

Analysis.—The same as for HCl (*q.v.*).

Poisoning by Iodine (I).

Source and Method of Occurrence.—Iodine is a manufacturing product prepared in large quantities for medicinal and other purposes. Iodine is rarely used as a poison. The Registrar-General's returns for 1901 are silent on the point. In 1864 an attempt was made by a woman to poison a fellow-servant by mixing tincture of iodine with food in a plate. The remarkable discoloration of the farinaceous food which it produced led to suspicion, and prevented any ill effects from following. Cases usually occur from overdoses and idiosyncrasy (*vide* "Potassium Iodide," p. 417). When in strong solution, it is corrosive and destroys the parts which it touches; in this state it has been maliciously employed for throwing on the person.

Toxicity and Fatal Dose.—A woman swallowed by mistake one drachm of iodine dissolved in an ounce of alcohol. When seen soon afterwards she complained of a violent pain in the throat or stomach, followed by retching and slight vomiting; the pulse was rapid and full, the eyes prominent and suffused. Vomiting, promoted by diluents, brought no relief to the symptoms. She became much depressed, and died on the following day. There was no examination of the body (*Prov. Jour.*, June 30th, 1847, p. 356). For a case of recovery after half a drachm had been taken, see *Med. Times and Gaz.*, 1861, 2, p. 669.

Symptoms.—From experiments on animals, as well as from observation of its effects on man, iodine has a strong local action as an irritant on the stomach and bowels. In large doses, it occasions a burning heat in the throat, severe pain in the abdomen, with vomiting and purging; the vomited matters having the peculiar odour of iodine, and being of a yellow colour, except when any farinaceous food has been taken, in which case they are blue or even black. The fæcal matters may also contain free iodine if the poison has been taken in the solid state. Besides these symptoms there is great thirst, with anxiety, headache, giddiness, trembling, and convulsive movements of the limbs and fainting; these last symptoms indicating that the poison has become absorbed. When taken for some time in small doses, it gives rise to salivation, vomiting, purging, pain in the stomach, and cramps; the pulse becomes small and frequent; there is a general wasting of the body; and it has been observed that in this form of chronic poisoning, certain glands are liable to become affected and diminished by absorption—the breasts in the female, and the testicles in the male. Iodine produces these secondary effects (iodism), whether it is taken internally or applied externally. For further remarks, *vide* "Potassium Iodide Poisoning," to the iodine of which compound the symptoms are mainly due. The rash, coryza, etc., there mentioned are sometimes seen when excessive doses of the tincture of iodine have been given.

Treatment.—Emetics and the stomach-pump may be used, together with general measures to relieve pain, etc., when acute symptoms are present. In other cases, stopping the administration of the drug is all that can be done.

Post-mortem Appearances.—As this is an irritant as well as a corrosive poison, the lining membrane of the gullet, stomach, and intestines may be found inflamed and excoriated. In one instance the mucous membrane near the pylorus was corroded and detached in a space of two or three inches.

Analysis.—The odour is in general sufficient to identify it. This may be concealed by alkalies or alkaline substances. When heated, it sublimes as a purple vapour. The addition of a cold solution of starch produces a blue colour, but many substances prevent this reaction. It is very soluble in disulphide of carbon, forming a rich pink solution. The sulphide has the property of removing it from water or organic liquids in which it is dissolved. It may thus be separated for chemical examination by decanting the watery liquid from the sulphide, which, on evaporation, leaves the iodine in crystals. Chloroform, a good solvent of iodine, may be substituted for the sulphide. Iodine gives a blue, green, or dark colour to most organic liquids, and imparts to them a peculiar odour. It stains the skin and other organic substances yellow; the colour being removed by an alkali.

Cases.—The editor is unable to find any recent cases of direct poisoning by iodine itself, but all the cases under the heading of "Potassium and Sodium Iodide" are probably due to the iodine in the compound.

Group 5.—ANÆSTHETISING AGENTS.

There is a convenience in grouping together the various substances which have from time to time been used for the purpose of producing anæsthesia, though amongst them are substances very different in origin, and also in action. Chloroform, for instance, is of purely synthetic origin in organic chemistry; nitrous oxide is also produced from inorganic materials; while cocaine is derived from a vegetable source. Again, the general anæsthetics produce death by their effect upon the cerebral centres, while cocaine probably affects peripheral nerves much more powerfully than the centres in the brain or cord. It is difficult, too, to decide the exact position of the new synthetic hypnotics which are constantly being put upon the market in increasing numbers, and certainly act in a manner very similar to anæsthetics; alcohol itself acts very similarly to chloroform or ether, and so do some of its derivatives, like paraldehyde, so that it becomes necessary to introduce subdivisions of the present group.

As a very pertinent introduction to the group we may well ask: "What is the essential quality to be sought for in a perfect anæsthetic?" It is easy to formulate a postulate that must be satisfied before any substance can be called a perfectly safe (local or general) anæsthetic or hypnotic, viz., it shall primarily (and if possible *only*) affect the higher (general sensation and mental) cerebral centres, leaving untouched, at any rate in a depressant direction, the lower (cardiac and respiratory) centres, and if used locally its effects shall be purely local, and under control by dosage. Such a perfectly safe general anæsthetic or hypnotic has yet to be discovered, and fatal accidents, even in skilled hands, will almost inevitably continue to occur from time to time; while the use of such dangerous drugs by ignorant persons, often rendered reckless, is sure to end in frequent disaster.

GENERAL ANÆSTHETICS.

The following list of anæsthetising agents is taken from the "Extra Pharm.," 1904, p. 785:—General anæsthetics: A.C.E.; ether; ethyl bromide; ethyl chloride; ethyl iodide; chloroform; anestile; somnoform; ethyl chloride combined with nitrous oxide; methylene; nitrous oxide. Used locally: ether; carbolic acid; anestile; anæsthesine; boldo; cocaine; erythrophlæinæ hydrochloridum; ethyl chloride; eucaine; holocaine; ice; menthol; methyl chloride; orthoform; "new" orthoform; nirvanin; tropacocaine.

Fatal accidents have occurred with almost all of them. Illustrations of the following will, however, alone be considered here in any detail. The reader is referred to the "Extra Pharm.," 1904, and to works on anæsthetics for further information.

Chloroform.
Ether (*vide* under "Alcohol," pp. 589 *et seq.*).
Nitrous oxide.
Bichloride of methylene, now known as methylene.

HYPNOTICS AND ANALGESICS.

It would be a large task to compile a complete list of these, and would serve no useful purpose. The reader may consult the "Extra Pharm." Modern organic chemistry is continually adding to the list, and the list of to-day differs from that of yesterday and to-morrow only by the weird names that are found in it. These substances as a body, however, constitute a very grave danger to public health, and the death-roll from them grows ominously longer every year.

Fatal (and other) cases of poisoning will be noted of—

Alcohol (including ether and fusel oil and paraldehyde).
Chloral hydrate and chloralose.
Trional.
Thalline.
Bromoform.
Acetanilide or antifebrin.
Exalgin.
Antipyrin.
Phenacetin.
Veronal.

Amongst the last six or seven of these agents there is considerable likeness in the method of the production of symptoms in this respect, viz., that they do not answer to the postulate stated above for safety; they affect rather the blood or the heart (its peripheral nerves or its centre) only too easily. We are at present too little acquainted with our heat-regulating mechanisms to be able to throw antipyretics of doubtful qualities amongst them without very serious risks of catastrophe.

Poisoning by Chloroform.

Source and Method of Occurrence.—Chloroform is now prepared in large quantities commercially for anæsthetic purposes, and also for use as a solvent. Questions have arisen from time to time as to the absolute purity of the chloroform used, but so far as the editor is aware they have not given rise to any medico-legal decisions.

As regards the method of occurrence of chloroform poisoning, probably over 99 per cent. are due to misadventure in the administration of it as an anæsthetic; suicides use it very occasionally, and cases from time to time arise in which it is given homicidally and for other criminal purposes, such as robbery and rape. In 1895, anæsthetics killed 70; in 1896, 54; in 1897, 127; and in 1898, 88.

In 1908 the Registrar-General reported the following:—

	Accident at Operation.	Suicide.
Chloroform	98	4
Ether	16	
Chlor. and eth.	4	
A.C.E. mixt.	6	
Anæsthetics (nature not stated) ...	81	

Ethyl chloride, nitrous oxide, and stovaine, 2, 1, 1.

Manuals on anæsthetics give much fuller statistics (*vide* Fr. Hewitt's "Anæsthetics").

In cases of alleged robbery and rape, it has been sometimes stated that the person assaulted was rendered suddenly insensible by chloroform; but chloroform vapour does not produce immediate insensibility. Anything like "immediate insensibility" at once stamps the tale with fraud.

The editor has omitted from the present edition any criticism on the various chloroform commissions; they do not really belong to forensic medicine. References to them are given below.

Toxicity and Fatal Dose.—*Chloroform Vapour.*—The vapour, when respired in a concentrated form, is speedily fatal to life. If it is diluted with a certain proportion of air, it produces insensibility, with entire loss of muscular power in from two to ten minutes, and the patient rapidly recovers after the vapour is withdrawn. Two or three per cent. of chloroform-vapour in the air is the safety limit now adopted.

In some instances death has taken place within two minutes from the commencement of inhalation. In one of these only thirty drops had been taken in vapour, but the patient died in one minute, and in another, so small a quantity as fifteen or twenty drops proved speedily fatal ("Table of Fatal Cases," by Warren, U.S., p. 23). Simpson suggested that in some of the alleged fatal cases death may have been really due to other causes of sudden death (*Med. Times and Gaz.*, 1870, 1, p. 224).

Its fatal operation is sometimes suddenly manifested after the withdrawal of the vapour. In one case, the heart suddenly ceased to beat four minutes after the vapour had been withdrawn. The digital arteries which had been divided in the operation suddenly ceased to bleed. The man was dead. Such rapidly fatal effects are generally ascribed to idiosyncrasy, or to the unforeseen condition of a fatty or flabby heart.

The methods by which chloroform when inhaled causes death would seem to be of three distinct kinds.

1. The vapour coming in contact with the mucous membrane of the larynx causes a reflex spasm of the muscles of that organ, thus throws them out of harmonious gear, and leads to asphyxiation of the patient. 2. Chloroform absorbed from the air-passages into the blood arrives at the heart, and acts as a direct muscle poison (? also a paralyser of the cardio-vascular centre). Dr. F. Hewitt believes that the former of these two methods is far and away the most frequent, and also notes the especial danger of other violent reflexes from the surgeon's operative activity acting on the respiratory and cardio-vascular centres. The second method is probably the one that usually operates when the drug is taken by the mouth. It is only in recent

years that the third method has been, one might almost say, discovered; it is spoken of as "delayed chloroform poisoning," by which is meant that the anæsthetisation and the immediate effects of the operation are both apparently successfully passed through by the patient, when there somewhat suddenly appear symptoms of very fatal omen, typically coffee-ground vomiting, frequent feeble pulse, and apathy deepening into coma. The time in which these symptoms appear is variable; thirteen, twenty-four (approximately), and eighty hours are recorded in the three cases in the *Lancet*, 2, 1909, p. 81, by Dr. Somerville. The ages of Dr. Somerville's cases were 4, 18, and 26 respectively, but from other cases it would seem that children are more liable to be affected. We append the full report of the second case from the *Lancet* (*loc. cit.*):—

The patient, aged 26 years, was admitted with symptoms of ovarian cyst with twisted pedicle. The operation was performed a few hours after admission and consisted in removal of the cyst, which was slightly adherent to the intestines. On the following day her progress was satisfactory. The patient had slept well, and she felt well, except for some slight vomiting after the operation. On the following evening—24 hours after the operation—my attention was called to the small quantity of urine passed, only about 16 ounces since the operation; a catheter was passed, but no urine was found in the bladder. On the following morning the patient was distinctly jaundiced, and the general condition was not good. About 10 a.m. she vomited a large quantity of "coffee-ground" fluid. The stomach was then washed out, and some saline and sodium bicarbonate solution was left in. The patient's condition seemed to improve. Plenty of fluid was given and was retained; five grains of calomel were also given. The patient again vomited at about 10 p.m., and from that time onward her condition was gradually getting worse. There was not much vomiting, but gradually becoming weaker, she died at 2 o'clock on the following morning – 60 hours after the operation and 14 hours after the first appearance of the "coffee-ground" vomit, so distinctive a feature of these cases. The temperature had never risen above 99° F., the pulse had gone up to 160 per minute, and the respirations had been normal. The urine, of which about four ounces had been obtained after the symptoms had set in, had given no reaction to the acetone test.

A limited post-mortem examination was made. No peritonitis was found. The specimens, which were kindly examined for me by Dr. Gough, showed the following points of interest. (*a*) The liver showed very characteristic changes. The centres of the lobules were quite disorganised, the cells were nearly all necrotic, and much brown pigment was present, and the peripheral parts of the lobules were in a state of advanced fatty degeneration. (*b*) The spleen showed little change except that many of the cells contained brown pigment granules. (*c*) In the pancreas the gland cells showed degenerative changes. No trypsinogen granules were present, but numerous fat globules were found in the protoplasm. (*d*) In the kidneys the glomeruli were normal, and the cells of the convoluted tubes were in some places in a state of advanced fatty degeneration and in others broken down into the lumen. (*e*) In the heart the fibres had almost lost their striation and were filled with fine fat droplets. The condition was not patchy, as in fatty degeneration usually found in anæmic states, but every cell was affected.

As a liquid it is not a very active poison, a fluid drachm being the smallest recorded fatal dose.

In 1854, a boy, æt. 4, swallowed a drachm of chloroform, and soon afterwards laid his head on his mother's lap and lost all consciousness. Thursfield saw him about twenty minutes afterwards. He was then insensible, cold, and pulseless. Mustard plasters were applied to the legs; they acted well, but produced no impression on the sensibility. His breathing varied; it was sometimes natural, at other times stertorous. He became warmer, his pulse full and regular; and he continued *three hours* in this state, when he died quite calmly, without a struggle.

There have been several committees appointed to consider the best means of administering chloroform, notably the Hyderabad Commission, which in 1891-2 investigated this question experimentally in India (see *B. M. J.*, 1891, 2, p. 1088), also a special report by the Brit. Med. Assoc. (*vide B. M. J.*, Supplement, July 18th, 1903, also *B. M. J.*, 2, 1904, and *B. M. J.*, 2, 1910).

Duration.—When chloroform is inhaled with a fatal result, the time that elapses between the first breath of chloroform and death is extraordinarily variable (*vide* above). The editor is of opinion that in many of the cases where death takes place rapidly, the fatal result is due to idiosyncrasy, rather than to any want of skill in the administration, or possibly laryngeal spasm; with regard to the cases of death after longer intervals up to even an hour or more, the reader is referred to Dr. Hewitt's work, where the matter is more fully discussed. It must be remembered that the border-line between death and the deep anæsthesia required for serious operations is but a narrow one.

When chloroform is swallowed and causes death, the fatal event rarely occurs for some time after the dose has been taken, generally five or six hours. It has been delayed as long as sixty-seven hours (*vide* below, under "Symptoms").

Recovery is apt also to be very slow, though commonly the symptoms (headache and nausea) have passed off in six to eight hours, especially if the patient falls into a natural sleep.

Symptoms.—These vary somewhat according to whether it is inhaled or swallowed.

If Inhaled.—The symptoms very commonly seem to be almost nothing, for after a few breaths the patient ceases to breathe and the heart stops, and death is present. More usually, however, there is a stage of excitement followed by one of narcosis, in which heart and respiration cease. Anæsthetists are even now of two opinions as to whether the heart or the breathing stops first, and undoubtedly both must be watched with great care (*vide* above, where the methods of death are mentioned). The one universally accepted sign of danger is a *fixed and dilated* pupil. Vomiting is a common result of chloroform inhalation, but not a symptom of great importance *per se* (but is to be avoided, because of the risks of aspirating the vomit).

If Swallowed.—Chloroform acts at first as an irritant, and may cause vomiting by direct action on the stomach within a quarter of an hour; should it not do so, however, the symptoms then are sleepiness, rapidly followed by unconsciousness, deepening in fatal cases to coma and death.

A man swallowed *four ounces* of chloroform. He was able to walk for a considerable distance after taking this dose, but he subsequently fell into a state of coma—the pupils were dilated, the breathing was stertorous, the skin cold, the pulse imperceptible, and there were general convulsions. He recovered in five days (*Med. Gaz.*, vol. 47, p. 675). A man swallowed nearly two ounces of chloroform. He was seen ten or fifteen minutes afterwards; he had already vomited, and was found insensible with stertorous breathing, and a pulse of about 60. The stomach-pump was employed, and some spirit of ammonia was injected. The pulse became more feeble, the breathing slower, and the pupils were insensible to light. The surface was cold, and for a time he continued to get worse, the face becoming purple, while the pulse was intermittent and hardly discernible. Two hours and a half after taking the poison, however, a gradual improvement commenced, but sensibility did not return until four hours later. For several days he continued to suffer from great irritability of the stomach, and eventually he had an attack of jaundice (*Amer. Jour. Med. Sc.*, October, p. 367; *Med. Times and Gaz.*, November 28th, 1857, p. 559). A man, æt. 42, swallowed two ounces of chloroform, and he died in about six hours afterwards. In this case the pupils were fully dilated, the breathing was stertorous, and the skin covered with cold perspiration. He rallied for a short time and then sank again, his lips becoming dark purple and his face livid. On inspection the lungs were found much engorged with blood, and there were some apoplectic effusions in these organs. The stomach was slightly inflamed in patches, and the mucous membrane was softened. It contained a dark fluid, smelling strongly of chloroform (*B. M. J.*, 1866, 1, p. 541, and *Amer. Jour. Med. Sc.*, October, 1866, p. 571). In some cases, alarming symptoms have been produced by much smaller doses, and one of these proved fatal. In March, 1857, a lady swallowed half an ounce of chloroform. In five minutes she was quite insensible, generally convulsed, the jaws clenched, the face slightly flushed, the pulse full and rather oppressed, and she foamed at the mouth. She vomited, and in twenty minutes the convulsions had left her; soon afterwards she had a relapse, and did not recover for twenty-four hours (*Med. Times and Gaz.*, 1857, 2, p. 615).

A man, æt. 58, of robust constitution, but given to drink, swallowed about 1½ fluid ounces of chloroform, with suicidal intent. Six hours later he was found in an unconscious condition. When seen by Brasch his face was flushed, the mucous membranes slightly cyanotic, the eyes closed, the breathing quiet, 20 per minute, but occasionally embarrassed, owing to falling back of the tongue. From time to time he vomited and passed fæces involuntarily. The pulse was small, 80 per minute, the cornea insensitive, the pupils not contracted, and not reacting to light or other stimuli. The patient was absolutely insensible, and could not be roused. One-thirteenth of a grain of strychnine was injected subcutaneously, and a quarter of an hour later $\frac{1}{32}$nd grain. The pulse became stronger, the patient began to move his hands and arms and to open his eyes for a moment or two; he spoke, though unintelligibly, and vomited mucus mixed with food. The vomited matter did not smell of chloroform. Ten hours after swallowing the poison the man recovered consciousness, and complained of thirst, a feeling of internal heat, and nausea. The vomiting continued, and next day there was great pain in the region of the liver, which was enlarged and tender. The skin and conjunctiva were jaundiced, the fæces slightly bloodstained. Towards the end there was great difficulty in passing water, and even with the catheter only a few drops of turbid yellowish urine could be drawn off. The patient became gradually weaker, and died sixty-seven hours after swallowing the poison, of paralysis of the heart and pulmonary œdema. The temperature was normal throughout, the intelligence clear to the last. No post-mortem examination seems to have been made (*Deutsch. Med. Zeitung*, April 7th, 1890; *B. M. J.*, 1890, 1, p. 1089).

Treatment.—For full details the reader is referred to Dr. Hewitt's (and other authors') work on anæsthetics. We can here only mention the outlines of the matter. If the drug has been swallowed, obviously the stomach must be emptied and well washed out (*vide* a curious case of the editor's, *infra*, under "Cases"). Subsequently stimulants to the heart and respiration must be administered, and artificial respiration maintained if necessary. Oxygen, strychnine, ether, alcohol, applications of electricity to the phrenics, may all be useful, or whichever of them happens to be available. In the ordinary anæsthetising cases a very important point is to see that the larynx is not obstructed in any way.

Post-mortem Appearances.—On opening the cadaver there is very likely to be a smell of chloroform, and when the drug is swallowed the stomach may show signs of irritation in patches; beyond these two signs, which, it must be noted, are neither of them constant, and both may be absent, nothing is to be noticed, and only a critical analysis will reveal the cause of death. There is quite likely to be some evidence of the disease, for the operative relief of which the anæsthetic was administered, and this must be carefully noted in case the question may arise as to whether death was due to the disease or operation or to the anæsthetic (*vide* Vol. I.). Several cases are reported in which fatty degeneration of organs has been found. This is typically so in the "delayed" cases.

Analysis.—Pure chloroform is a heavy colourless liquid (sp. gr. 1·5), crystallisable at very low temperatures, neutral in its reaction, sinking in water, and only to a slight extent dissolving in that liquid. The B.P. preparation has its sp. gr. between 1·490 and 1·495, and contains 0·2 per cent. of alcohol. It has a fragrant odour, and is dissolved by alcohol and ether. A solution in alcohol, in the proportion of one part by measure to nineteen parts of rectified spirit, forms the *Spirit of Chloroform.* Chloric Ether is a similar, but stronger, solution. Chloroform is highly volatile, but its vapour is not inflammable and not readily combustible. Nitric and sulphuric acids produce no change in it. It boils at 142° F., and evolves a vapour which at a red heat yields chlorine and hydrochloric acid. On this effect processes have been based for separating it from the *blood and tissues*, when it has proved fatal in the form of vapour. The substance supposed to contain chloroform is placed in a flask. The neck of the flask is fitted with a cork perforated to admit a hard glass tube, bent at right angles, and having a length of from twelve to fifteen inches. The flask is gradually plunged into water at about 160° F., and at the same time the middle portion of the tube is heated to full redness by gas jets. At a red heat chloroform vapour is decomposed, and chlorine and hydrochloric acid are among the products of its decomposition. Litmus paper applied to the mouth of the tube is reddened; starch paper moistened with iodide of potassium is rendered blue, and nitrate of silver is precipitated white. Two drops of pure chloroform were thus readily detected, and so persistent was the vapour in the closed vessel, that it was detected after one, two, and even three weeks. Two drops added to a quantity of putrefied blood were detected by a similar process after a fortnight, the flask being closed, but the mouth of the tube remaining exposed to air.

As chloroform is much more volatile than ether, and its odour is not so pungent, it is not so easily detected in the dead body by the smell. The body should be inspected as soon as possible, and any solids or liquids intended for examination should be kept in well-closed glass vessels. If the smell can still be perceived in the blood or organs, the vapour may be easily detected by the method above described. Chloroform, if not eliminated or lost by its volatility, may have been converted in the blood into formic acid, and thus removed from the ordinary processes of chemistry.

Sir Thos. Stevenson has found no difficulty in detecting chloroform in the blood of a person killed by its inhalation, even when the body was not examined till twenty-four hours after death. The flask above is fitted with a second tube, open at one end to the air, whilst the other end passes beneath the liquid to the bottom of the flask. This serves as an inlet for air. The exit tube is heated through a length of at least eight inches by a series of lamps; and its further end is attached to a set of Liebig's bulbs, filled with a strong solution of nitrate of silver. Air is aspirated through the apparatus during the course of the experiment; and the presence of the slightest trace of chloroform or other volatile compound of chlorine is immediately revealed by the formation of a white cloud of chloride of silver in the solution of nitrate of silver.

Pohl ("Archiv fur expt. Path.," xxviii., Heft 3 and 4, 1891) describes at length his method of estimating chloroform quantitatively in animal fluids. A current of air is passed through the mixture for many hours; it takes up the chloroform, and the mixture of air and chloroform being led through a heated tube filled with pure magnesia, the chloroform is decomposed, and can be estimated quantitatively by the amount of chlorine which it yields to the magnesia. Preliminary experiments with known quantities of chloroform convinced him that the method gives almost absolutely exact results. The experiments were made on dogs deeply under the influence of chloroform. In the blood drawn from such an animal there was got from 0·01 to 0·06 per cent. chloroform, the average amount being 0·035 per cent., being much less than the solvent power of blood for chloroform. The red corpuscles contained about two and a half times more than the serum. The greater part of the chloroform is therefore combined with the red corpuscles. The amount of chloroform in the brain, liver, urine, and fat relatively to the amount in the blood was also estimated. In a dog in which the blood contained 0·015 per cent., the brain (after death by bleeding) contained 0·0418 per cent. In another dog where the blood contained 0·062 per cent., the liver contained 0·044 per cent. Only traces were got in the urine. The fat contained less chloroform than the blood, but the author attributes this to its very small blood supply. The organs rich in substances which are soluble in chloroform seem to take it up in relatively large amount and quickly. After cessation of administration the blood reabsorbs it again, and it is excreted by the lungs, the excretion going on for forty minutes at least.

Solutions containing even traces of chloroform evolve the unpleasant odour of phenyl isocyanide when boiled with alcohol and a little caustic potash, on the addition to the boiling liquid of a drop or two of aniline.

Cases.—Some years ago a nurse at the London Hospital, working in the out-patient department, took the chloroform bottle to her bedroom with her and swallowed an unknown quantity. She was found before life was extinct. Her stomach was well washed out, and many other remedies administered, in spite of which she died about twelve hours after taking the drug: on autopsy a curious condition was found which explained the difficulties of treatment. She had an hour-glass stomach from cicatrisation of an old ulcer, and while the proximal end had been washed out the pyloric compartment smelt strongly of chloroform; in other respects there was nothing unusual in the case.

The following case, reported by Drs. Waterson and Robinson, is interesting from the great prolongation of the period of unconsciousness:

A robust housemaid, aged nineteen, finding herself three months pregnant, took with her to her bedroom on a Friday night a bottle of chloroform, and swallowed three fluid ounces of the liquid, most probably between 3 and 4 a.m. on the Saturday morning. At 6.30 a.m. her mistress found her lying with her head over the side of the bed, her cheek resting on the floor. She was snoring loudly and was quite unconscious. Dr. Waterson saw her shortly afterwards, and called in

Dr. Robinson at 8.30 a.m. She was in bed, perfectly unconscious, with complete muscular relaxation, flushed face, and widely dilated pupils; the corneæ were insensitive. The pulse was regular and full. Her mouth and breath smelt strongly of chloroform. The stomach pump was applied with little result; the fluid which returned did not smell much of chloroform. Strychnine gr. $\frac{1}{20}$ was injected hypodermically, and the dose repeated two or three times during the day. Enemata were given to unload the bowels, so as if possible to get rid of some of the poison; they were not relieved, however, till about 3 p.m. Enemata of strong coffee and of brandy were also given. The mouth gag was used, and the tongue kept well forward all the day. The breathing kept good and the pulse natural. At 4 p.m. consciousness returned after an absence of twelve hours. In the evening she was removed to her home in a cab, and her sister states that she made an excellent recovery from the chloroform (*B. M. J.*, 1, 1898, p. 144).

In 1886, a woman was tried for murder of her husband, and it was alleged that she had poisoned him with liquid chloroform, poured down his throat whilst he was asleep; but she was acquitted (*R.* v. *Adelaide Bartlett*, C. C. C., April, 1886).

In April, 1904 (C. C. C., *R.* v. *Hallam*), the prisoner was sent to penal servitude for life for administering chloroform to his two children with intent to murder or do them bodily harm. Prisoner seemed to have been brooding over some imaginary grievance at the hands of his wife, and early in February he took an unfurnished flat in Maple Road, Camberwell. He bought a lot of chloroform, and taking the children to the flat he gave them some of the drug. The next thing they remembered was waking up, feeling very sick and ill, on what they imagined was Monday morning, but, as a matter of fact, it was Tuesday, and they had been either asleep or unconscious for two nights and a day. It appeared that a man named Cochrane had lodged with prisoner and his wife, and that Hallam had been jealous. The whole thing might have been an attempt, on the prisoner's part, to frighten his wife or to be revenged upon her for some imaginary slight, but it was clear that, whatever his motive was, he endangered the lives of his children.

The jury, after a brief deliberation, found the prisoner guilty of administering chloroform with intent to murder, but added that they considered he was labouring under delusions at the time. He was sentenced to penal servitude for life.

A death in an adult from swallowing an ounce of chloroform is recorded in the *Lancet*, 2, 1897, p. 384.

The following, reported by Dr. Hayward in the *Lancet*, 2, 1902, p. 1122, is inserted for its completeness:

A woman, aged thirty-nine, who had been drinking heavily for some days previously, was found in bed in an unconscious condition between 1 and 2 p.m. Her night-dress and the bed-clothes were saturated with an exceedingly offensive blood-stained vomit and fæculent matter, and an empty bottle which had contained two ounces of pure chloroform was found by the side of the bed. A fellow-servant had seen her in bed and apparently sleeping naturally at 11 a.m. When seen by me at 2.30 p.m. she was in a deeply comatose state—the face blanched, lips and fingers livid, and the trunk and extremities cold; the pulse imperceptible at the wrist, heart sounds very feeble, breathing shallow but regular, and air entering the lungs. The corneæ were insensitive, the pupils equal, semi-dilated, and feebly acting to light. The breath smelt of alcohol, with a suspicion of chloroform, and there was no staining or whitening of the lips or mucous membrane of the mouth.

Having no apparatus at hand, I directed that the bed should be raised, and warm bottles and friction applied to the trunk and limbs, while I left to fetch a stomach tube and hypodermic syringe. On my return, after twenty minutes, I found that the patient had partially recovered consciousness, and had vomited a quantity of dark, chocolate-coloured fluid, and passed a few ounces of bright blood per rectum. The pulse was still imperceptible, but the corneal reflex had returned, and the limbs responded to stimulation, while she occasionally muttered a few incoherent words. As she appeared to be recovering consciousness, and had vomited freely, it was thought better not to wash out the stomach, which might have entailed risk from heart failure, and the possible chance of fluid entering the lungs. A hypodermic injection of $\frac{1}{10}$ gr. strychnine was given, the foot of the bed raised still higher, and warmth and friction to the extremities continued. As the breathing was stronger and quite regular, it was not considered necessary to employ artificial respiration. The general condition continued to improve, though the heart's action remained excessively feeble. At 4.30 p.m., after she had so far recovered consciousness as to complain of pain in the abdomen, a violent attack of retching occurred; the patient collapsed over the side of the bed, the pupils became widely dilated, the heart ceased beating, and death ensued almost suddenly, the respiration continuing for a few gasps after the heart sounds had ceased to be heard.

A necropsy was made 24 hours after death. Rigor mortis well marked. Thorax: The right side of the heart contained dark coloured blood and no clots; the left side empty, valves normal, walls firm, bright red in colour; weight 13 ounces. Lungs natural on both sides, crepitant, and not œdematous. Abdomen: The peritoneal cavity contained several ounces of dark blood-stained fluid, no lymph on walls of intestines, the small intestine intensely congested and dark red in colour, the large intestine congested to a lesser degree. The stomach contained about one ounce of dark chocolate-coloured fluid smelling of chloroform, the walls slightly congested with a few scattered ecchymoses and patches of post-mortem digestion. The interior of the small intestine was intensely congested throughout, the mucous membrane swollen, velvety, and of a dark cherry colour with numerous ecchymoses, and contained a quantity of dark-red fluid smelling strongly of chloroform. These appearances were much less marked in the interior of the large intestine which contained no solid matter. The liver was large, weighing 3½ pounds, pale in colour, somewhat friable. Spleen, kidneys, and pelvic organs normal. The mucous membrane of the œsophagus was very slightly congested and showed no ecchymoses on its walls. Brain firm, normal, the cranial sinuses contained dark fluid blood and no clots. The presence of chloroform in the intestines was confirmed by distillation of the fluid contents. On heating the glass tube leading from the retort, evidence of chlorine gas was obtained by its action on iodised starch paper, and on litmus. The general result of the examination pointed to intense irritation and congestion of the alimentary tract, most marked in the duodenum and small intestine, and to a lesser degree in the stomach and large intestine. The condition of the liver may have been due to fatty change, the result of long-standing alcoholism; the cherry-red colour and fluid condition of the blood in the heart and cranial sinuses are also noteworthy.

The following, though not strictly a case of chloroform poisoning, deserves to be recorded as a warning to surgeons:

A man who had received a gunshot wound of the abdomen was brought to the hospital and was, of course, operated on. The operation was very difficult, and chloroform administration had to be kept up for about four hours. Gas was the illuminant used in the operating room, and it appeared that the gaslight decomposed the chloroform with evolution of powerful chlorinated vapours, which overcame the two surgeons and the Sisters of Mercy. One of the sisters died on the second day and the lives of the others were in great danger (*Lancet*, 1, 1898, p. 611).

The following case of **chloroform habit** may perhaps only be rare by reason of its fatal ending, though the editor cannot find any similar recorded case:—

In October, 1904, an inquest was held at Liverpool on the body of Dr. L. Roberts, who was found dead in an hotel. It was given in evidence that for twenty years he had been in the habit of inhaling chloroform in order to enjoy the beautiful dreams he experienced when under its influence. He would have a bout which would last a few days at a time. His father, relations, and friends did all they could to help him, and tried to persuade him to break off the habit, but he had got beyond that. At times when this bout came on he would absent himself from home for a day or so and even longer. At his death no less than eight chloroform bottles were found in his pockets [evidence does not say empty or full—Ed.]. Medical evidence showed that the chloroform had been inhaled, not swallowed. The verdict was "misadventure"—probably a correct one.

For a similar fatal case *vide Daily Telegraph* for Feb. 13th, 1905.

A laboratory boy at the London Hospital Medical College had to be discharged on account of an incurable habit of inhaling chloroform on every possible opportunity.

POISONING BY NITROUS OXIDE GAS (LAUGHING GAS).

Source and Method of Occurrence.—This gas is now produced in enormous quantities from pure chemical sources for purposes of general anæsthesia. Judging by statistics, it would seem to be the safest of all general anæsthetics (Hewitt, "Anæsthetics"). Fatal cases arise practically in only one way, viz., accidentally in the course of surgical operations. The first recorded case was in 1873, since which date they are not very rare. Fatal cases are recorded from time to time—about one in 30,000 administrations.

Toxicity and Fatal Dose.—The gas is but little poisonous, enormous quantities being sometimes inhaled without any inconvenience, not to speak of bad symptoms. The fatal dose is absolutely unknown, but, as with other anæsthetising agents, it probably varies enormously owing to idiosyncrasy, *q.v.*, p. 311.

Duration.—Nothing can be said positively on this point. When it is fatal it usually is so within a few minutes of the inhalation. Insensibility is produced in anything from 20 to 200 seconds, and can be maintained with care for an hour if necessary, though the gas is usually only given for short operations.

Symptoms.—As in other cases of general anæsthesia, the symptoms of inhalation of the gas are, first, a short period of exalted ideation, followed by rapid unconsciousness. When death ensues it is through the action of the drug on either the cardiac or respiratory centre. The victim becomes livid, with a cold clammy sweat possibly breaking out.

A woman, æt. 48, was under the influence of the gas in one minute. It was continued for five minutes longer, without any admission of air. At the end of this time she was unusually blue, and the breathing and pulse were very slow and failing. The gas was removed and the woman was turned over on her left side. This woman must have been very near death, and probably would have died had she been in the sitting posture. She gradually recovered, and walked away in five minutes more. One man who began to imbibe the gas for the extraction of a tooth pushed away the inhaler, and refused to continue breathing the gas. He complained of very unpleasant symptoms in his head for some hours after, but these passed off. One woman complained of headache. In one case, that of a child æt. 4, vomiting followed. In a child æt. 3, where anæsthesia was maintained for a minute and a half, two intervals of breathing air having been allowed, the respiration ceased and the pulse sank so as to be scarcely perceptible for several seconds. The gas was removed, and the child was turned slowly over on his left side. He gave a deep sigh, the pulse and breathing gradually returned, and he completely recovered in five minutes.

Analysis.—It would be useless to attempt to extract the gas from the dead body, but in bulk it may be recognised by the following tests: (1) it supports combustion very readily, (2) it has a sweetish taste, and (3) it causes general anæsthesia.

Cases.—In January, 1873, this gas was administered by a dentist to a lady, æt. 38, at her own desire, in order to prevent pain during the extraction of a molar tooth. A physician carefully examined her before the operation, and found nothing to preclude the use of the gas. The nitrous oxide was pure; it had been safely used for other patients from the same condenser, and an apparatus was employed so as to secure the removal of the expired air. The total quantity administered was about six gallons. Soon after the commencement of the inhalation it was observed that the pulse became rapid and less full; the patient was then sensible, and the apparatus was removed. The operation was commenced, but the lady insisted on having the gas again. She took it; insensibility came on, and the operation was completed. Immediately afterwards the face became livid, the features began to swell, and the tongue protruded. In spite of every effort to restore her, she did not recover from the state of insensibility; she breathed two or three times, and the pulse then ceased. No inspection of the body was made. The above-mentioned facts were given in evidence at the coroner's inquest, and the medical opinion was that death had been caused by the gas in producing paralysis of respiration, and that in this case no forethought could have prevented the result. The jury returned a verdict of homicide by misadventure (*Lancet*, 1873, 1, p. 178).

Since this case, several deaths under nitrous oxide or "laughing gas" have been reported. For particulars of them the reader is referred to works on anæsthetics.

Poisoning by Bichloride of Methylene.

The vapour of this highly volatile liquid has been used as a substitute for the vapour of chloroform in surgical operations. It was thought to be less likely to cause death. Like all anæsthetic vapours, it has, however, destroyed life on several occasions, even when given with care. The history of these fatal cases is similar to that which chloroform vapour has furnished on numerous occasions.

Symptoms and Appearances.—An operation for artificial pupil was about to be performed on a man, æt. 40. The vapour of the bichloride was given, and five minutes afterwards, when the operation had just commenced, the face of the man became livid, the breathing difficult, and the heart suddenly ceased to beat. On inspection, the principal appearance was congestion of the lungs. In another case, a man inhaled, for the purpose of a trivial operation, a drachm and a half of the bichloride. It was given in the usual way by an experienced person, and was stated to be not more than one-half of the usual dose. The deceased became insensible—the operation was completed in a minute—when it was noticed that the patient's head had fallen on one side, his eyes were upturned, and breathing and pulsation had ceased. Animation could not be restored. On inspection all the organs of the body were found healthy. There was no cause for death but the vapour of the bichloride (*Pharm. Jour.*, 1871, p. 875). This preparation has been sometimes used in hospitals under the name of chloroform. In 1869, a man to whom the vapour was administered at Charing Cross Hospital, died in two minutes from the effects, although administered with care, and by one experienced in the use of chloroform. The allegation, therefore, that this vapour possesses any greater degree of safety than chloroform in surgical practice is not supported by facts.

Analysis.—This liquid has a peculiar odour, resembling that of chloroform. It is not inflammable, but burns in contact with flame with a smoky combustion. It is not very soluble in water, but sinks in it, the globules having an opaque appearance. It has no acid reaction. Nitrate of silver gives no precipitate with it. In contact with sodium and a small quantity of water, it is rapidly decomposed without combustion; the liquid acquires a yellowish colour, and chlorine is then readily detected in it by nitrate of silver.

A mixture of chloroform and ether has been sold as bichloride of methylene.

POISONING BY CARBON TETRACHLORIDE (CCl_4).

Source and Method of Occurrence.—This substance is a volatile liquid, with peculiar smell, manufactured in chemical laboratories for various purposes, amongst which must be reckoned that of being used for "a dry shampoo" at hairdressers' establishments. The editor has made some inquiries on the subject, and finds that most of these places have abandoned the use of the drug as too dangerous for use in cleaning hair in an ordinary way. He cannot find that it is ever used as an anæsthetic in human beings, notwithstanding the statement by Dr. Spilsbury that its fatality rate is one in 20,000.

Toxicity and Fatal Dose.—The substance has long been recognised by chemists as having an anæsthetic action when its vapour is inhaled, and as giving rise to unpleasant symptoms under these circumstances, but no fatal case was recorded previous to July, 1909, when the quantity used was unknown, and certainly the quantity inhaled. The fatal dose must therefore be left as undetermined. Evidence was, however, given to the effect that it was used by the firm in question very frequently indeed without ill effects.

Duration.—Judging by the solitary case below, the action must be considered to be very rapid, analogous to that of chloroform vapour, to which substance its smell and composition have a close affinity.

Symptoms.—Faintness and collapse, which rapidly proved fatal, were the only ones noticed by the witness of the death. In the non-fatal cases faintness and a sense of suffocation are those complained of.

Treatment.—Instant escape from the vapour is the only chance. Death is apparently very rapid, leaving but little time for treatment. Artificial respiration in a pure atmosphere and general stimulants seem to offer some hope.

Post-mortem Appearances.—None characteristic except the smell.

Analysis.—For toxicological purposes the smell would be the only means of detecting the cause of death. Any of the liquid left can be analysed by ordinary processes.

Case.—The only reported case appeared in the form of an inquest on a lady, between twenty and thirty, who died suddenly while being dry-shampooed on July 16th, 1909. The inquest is reported in the daily press for July 19th, 1909. The details add nothing to what is stated above.

POISONING BY ALCOHOLS AND ETHER.

Source and Method of Occurrence.—Of the source of ordinary ethyl alcohol or spirits of wine, no account need be given, but it must be mentioned that by the plural alcohols it is intended here to include two other alcoholic bodies, viz., fusel oil, and methyl alcohol or wood spirit; so far as has been ascertained, their action on the human body is closely identical with, but more powerful than, that of ethyl alcohol, and they leave more constitutional disturbance behind them on recovery.

Commercial methylated spirit is a mixture of uncertain proportion (and hence not recognised in the British Pharmacopœia, even for the making of liniments) of methyl alcohol or wood spirit, with ethyl alcohol or spirit of wine; for revenue purposes the addition of the methyl alcohol is ordered, so that the resultant may be too nauseous to be drunk (it is taken all the same by museum attendants of intemperate habits).

Fusel oil is the common name for primary amyl alcohol ($C_5H_{11}OH$) mixed with primary and secondary propyl alcohols. In England it goes by the name of "faints," and can be obtained gratis from some distilleries. Fusel oil is popularly used as an external application for rheumatism. It is obtained from fermented grain or potatoes by continuing the process of distillation after the ordinary "spirit" has ceased to distil over, and forms an oily liquid with a burning acrid taste and an odour said to resemble jargonelle pear. It has intoxicating and poisonous properties superior to those of ordinary spirits, and is said to be known in some of the northern countries of Europe to the consumers of corn brandy who frequently ask to be served with a "glass of good fusel" (*Lancet*, 2, 1901, p. 606).

All cases of ethereal and alcoholic poisoning are accidental: these bodies can hardly be used for homicidal purposes, and assuredly not for suicidal. Alcohol may act as a poison by its *vapour*. If the concentrated vapour be respired, it will produce the usual effects of intoxication. There is a case on record in which a child two years of age was thrown into an stupor by the alcoholic vapour of eau de Cologne.

Toxicity and Fatal Dose.—The toxicity of alcohol is very slight, and custom can make it practically *nil*, but for children and those unaccustomed to it, it is not infrequently fatal; thus two ounces of gin are said to have been fatal to a child, and half a pint of the same spirit to an adult.

Dr. R. Hunt, in the *John Hopkins Hospital Bulletin*, has recorded some valuable observations on poisoning by methyl alcohol. The coma due to ethyl alcohol is as a rule of not more than six hours' duration, never lasting more than twenty-four hours, whilst in the case of methyl alcohol it may persist for two, three, or even four days. Methyl alcohol is retained longer in the nerve tissues and is thus cumulative. In experiments on animals degeneration of the optic nerve and blindness were observed in fatal cases. Professor Würdermann has published in *American Medicine* two cases of poisoning by the inhalation of the fumes of methyl alcohol. The symptoms were frontal headache, dizziness, and nausea, followed by loss of sight. He found that the prognosis of toxic amblyopia the result of methyl alcohol was worse than when it was due to ordinary alcohol or to tobacco (*Lancet*, 2, 1902, p. 1772).

Duration.—This is very uncertain; in general the symptoms produced by a poisonous dose of alcohol come on in the course of a few minutes. There is confusion of thought, with inability to stand or walk, a tottering gait, and giddiness followed by stupor and coma. Should the person recover from this stage, vomiting supervenes.

On the other hand, coma may not supervene till the patient has gone through a prolonged stage of ordinary intoxication.

Symptoms.—Ether, when swallowed in moderate doses, has a hot burning taste, and produces during swallowing a sense of heat and constriction in the throat. It causes great excitement and exhilaration, followed by intoxication, but persons may become habituated to it, and thus after a time it may be taken in very large quantities with comparative impunity. It appears that within the last few years the practice of ether drinking has become prevalent within a limited area in the North of Ireland. Its immediate effects are similar to those of alcohol, but are more rapidly produced, and more transient.

As to the effects of ether upon the duration of life, little is known (see *B. M. J.*, 1890, 2, p. 885; 1891, 1, p. 659). Ether as a liquid has not, so far as is known, destroyed life; but when its vapour has been breathed, it has caused death in several instances.

The forms of alcoholic poisoning may be thus briefly tabulated.

ACUTE.

(1) Ordinary drunkenness up to sleepiness (patient capable of being temporarily roused).

(2) The same culminating in dangerous coma (patient totally incapable of being roused).

CHRONIC.

(3) The cirrhotic liver type with large tough kidneys.
(4) The peripheral neuritis type.
(5) The central neuritis type, alcoholic dementia and lunacy.

1. ORDINARY DRUNKENNESS.

To attempt to describe even briefly the thousand different symptoms of intoxication is impossible, but the editor feels that he ought not to leave the subject of alcoholic intoxication altogether without some reference to the work of police surgeons, who are so frequently called upon to decide whether a person in the custody of the police is drunk or not, and, indeed, he was asked by one of these gentlemen to frame some rules which might serve as a guide to those engaged in such work, and so offers the following, although fully conscious of the difficulties of the situation.

Now, though alcoholic excess is a moral offence against the individual's own welfare, it does not come within the purview of the police unless accompanied by some act which is either dangerous to the life or property of the individual, or annoying or possibly dangerous to others. Thus a person is never charged with being simply drunk, but with being drunk and incapable or drunk and disorderly, drunk in charge of a vehicle, etc., etc., and the proof of the fact of drunkenness or sobriety is required by the magistrate or judge as a very material fact in apportioning punishment, or, indeed, in judging of the merits of the whole proceedings.

I suggest then that "drunk" should be defined as "the" (not a) "mental condition which arises in sentient beings (here human) as the result of taking alcoholic (usually), or ethereal (less commonly), or other intoxicating (still more rarely) material." Let that stand as a bald definition of the state, and then, for the purpose of judicial proceedings, I would go on to add, "A person is drunk, within the meaning of the proceedings, if this mental condition has led him to behave in the manner which led to the proceedings."

This, after all, is the real essence of the situation, and means, Would this person have done what he did if he had not drunk the liquor (or taken the drug) that he had drunk (or taken)?

I feel that this definition is very wide, and must indeed include a great deal that has nothing to do with police nor law, nor, indeed, that is necessarily reprehensible, but nevertheless I feel that it would avoid much unnecessary hard swearing, and cannot lead to any real injustice, for a simple question from the president of the court would take the place of all medical and police evidence: "Would you have acted in the way proved if you had not had the liquor?" The same question, put by the police surgeon, would similarly clear up his difficulties.

Until the time arrives when some such simple plan is adopted, the police surgeon will do well to remember the following points: (1) that quantity drunk is quite immaterial; an epileptic or even a temperate man may get quite as "forward" on half an ounce of whisky, as some other persons on a pint. "Excess of liquor" has no meaning independent of the person who takes it. (2) That in those who have drunk sufficient to rob themselves of self-control it is usual to find:—

(*a*) The pupils act to light more sluggishly than usual, and the conjunctivæ are somewhat congested.
(*b*) The lips are dry and sticky.
(*c*) The expression of the face is somewhat vacant.
(*d*) The breath smells of liquor (*vide* below).
(*e*) Conceptions of the passage of time are vague and hazy.
(*f*) Ideas are probably arising with great rapidity, and attempts more or less coherently successful are being made to express them; the voice may be unsteady and thick on prolonged efforts at speech, though there may be, on the other hand, considerable taciturnity.
(*g*) The gait is likely to be unsteady.

The first and the last two will be found to be the most reliable when a police surgeon is trying to estimate, not so much "Is this person drunk now?" as "Was he drunk when arrested?" possibly an hour or two ago, a point very important in such cases.

2. ALCOHOLIC COMA.

The insensibility produced by alcohol may not come on until after a certain period, and then suddenly. Christison met with an instance in which a person fell suddenly into a deep stupor, some time after he had swallowed sixteen ounces of whisky, without any of the usual premonitory symptoms. In another instance, a person may apparently recover from the first effects, and then suddenly become insensible and die convulsed. There is a ghastly or vacant expression in the face, which is sometimes suffused and bloated; the lips are livid, and the pupils are dilated and fixed: if they possess the power of contracting under the influence of light, it is a favourable sign. The whites of the eyes are generally much suffused. The more concentrated the alcohol, the more rapidly are the symptoms induced, and they are also more severe in their character. Dilute alcohol commonly produces a stage of excitement before stupor, while in the action of concentrated alcohol there may be profound coma in a few minutes.

This **coma requires to be differentiated** from apoplexy, concussion, and other forms of coma, one aspect of the old question "drunk or dying?" the easier one for the medical man because, in any case of genuine insensibility or coma, the condition of the patient is a serious one, and he *must not* be left in a police cell, but must be placed under careful supervision and treatment, either at home or in a hospital.

For a complete analysis of the position *vide* the editor's work on "Differential Diagnosis" (Macmillan), or "Lect. on Med. Jurispr." (Churchill). The headings of what is there fully discussed are—

(1) The history, if obtainable, may decide the matter offhand.

(2) Note the pupils; dilated—alcohol; contracted—opium; unequal—hæmorrhage into or injury of the brain; active or not to light; if inactive the case is serious, whatever be its precise nature.

(3) Temperature: raised—hæmorrhage into pons; lowered—signifies *danger*, but does not differentiate the source of it.

(4) Localised paralysis, as opposed to general helplessness, suggests an asymmetrical lesion, probably hæmorrhage or softening.

(5) The urine should be examined; will differentiate diabetes certainly; its specific gravity may suggest cirrhotic kidneys with uræmia or brain mischief; and blood in it will also give a strong line for diagnosis.

(6) The general appearance of the skin: flushed and sweating (probably alcohol), cold and blue (collapse from other poison), or cold and sweating (opium).

(7) The breath may be smelt. If no odour of alcohol, it is practically certain that the case is not "drunk"; if an odour, this is not of much value without some history of how, or why, the alcohol was taken, and it excludes neither apoplexy nor any other serious condition. A smell of opium, carbolic, or any other definite drug than alcohol, is strong presumption in favour of poison.

The other, infinitely more difficult aspect of this question is that in which a **condition of excitement or active stupidity**, really due to gross organic disease, and shortly to be followed by a fatal coma, is mistaken for the pre-comatose stage of drunkenness. It is mistakes made in this direction that have so frequently led to severe strictures being passed by the public press on private practitioners, on police surgeons, and on hospital resident medical officers.

To clear up the matter precisely, the same observations should be made as in the cases of coma, but there are difficulties in the way in that (1) the person concerned may resent the examination by violent struggles or otherwise, and (2) he may only be observed at a distance performing stupid actions which are attributed to drunkenness, but are in reality due to serious disease. In the former case he *must* be kept under careful professional attention till an examination can be made; in the latter case a medical witness must be firm, but cautious, in the deductions he draws from his post-mortem examination (*vide* for such a case Vol. I., under "Head Injuries").

Treatment.—In the ordinary forms of alcoholic intoxication, nothing is required but to let the patient sleep it off under observation. If coma with fixity of pupils has come on, the stomach should be emptied, and hot, strong coffee administered, and efforts made to rouse the patient. It is the activity of this treatment compared with the measures required for apoplexy, for poisoning, for meningeal hæmorrhage, or for other acute cerebral affections that renders the diagnosis so important.

Post-mortem Appearances.—The inspector must be careful to smell the contents of the stomach, though it is possible that the smell may have disappeared.

Alcohol undoubtedly acts as an irritant of mild degree to the stomach. The stomach has been found intensely congested or inflamed, the mucous membrane presenting in one case a bright red, and in another a dark red-brown colour. When death has taken place rapidly, there may be the peculiar odour of some form of spirits in the contents; but this will not be perceived if the quantity taken was small, or many hours have elapsed before the inspection is made. The brain and its membranes are found congested, and, in some instances, there is effusion of blood or serum beneath the inner membrane. [It is extremely doubtful whether this is ever seen in cases in which violence or disease can be excluded, *i.e.*, as a result of alcohol pure and simple.—Ed.] In a case in which a pint of spirits had been taken, and proved fatal in eight hours, black extravasation was found on the mucous membrane of the stomach; but no trace of alcohol could be detected in the contents (*Dub. Med. Press*, 1, 293). The action of a strong alcoholic liquid on the mucous membrane of the stomach so closely resembles the effects produced by arsenic and other irritants, as easily to give rise to the suspicion of mineral irritant poisoning.

A girl was found at four o'clock in the morning lying perfectly insensible on the floor. She had had access to some brandy, which she had swallowed from a quartern measure found near her quite empty. She had spoken to her mother only ten minutes before, so that the symptoms must have come on very rapidly. She was seen by Adams four hours afterwards. She was then quite insensible, in a state of profound coma, the skin cold and covered with a clammy perspiration. There had been slight vomiting. The child died in twelve hours, without recovering consciousness from the time at which she was first found.

On inspection, there was injection of the brain and its membranes: the heart and lungs were quite healthy. The mucous membrane of the stomach presented patches of intense redness, and in some places it was thickened and softened; portions of it were detached and hanging loosely in the stomach; and there were patches of black extravasated blood about it. It contained a greenish-coloured liquid, but there was no smell of brandy in it, neither was this perceptible in the breath of the child, four hours after the alcoholic liquid had been taken. At first it was suspected that arsenic had been administered; but the symptoms were not those of arsenical poisoning, and neither arsenic nor any other metallic irritant was present in the contents of the stomach. Traces of alcohol were detected by the process described below.

A drawing in the museum at Guy's Hospital furnishes a good illustration of the local action of alcohol: the whole of the mucous membrane of the stomach is of a brownish-red colour, and highly corrugated. No other liquid largely affecting the brain has so intense a local action on the stomach.

Analysis.—When a large dose has been taken and the case has proved rapidly fatal, the contents of the stomach may have the odour of alcohol, or of the alcoholic liquor taken. The odour is not always perceptible, or it may be concealed by other odours. In a case of poisoning by gin, the liquid drawn from the stomach by the pump after seven hours had no odour. In the case of the child already related, the smell of brandy had entirely disappeared in twelve hours. The whole of the contents or of the suspected liquid should be distilled in a water-bath, with a proper condensing apparatus attached. If the liquid has an acid reaction, it should be first neutralised by a solution of carbonate of sodium. The watery liquid obtained should be mixed with fused chloride of calcium or anhydrous sulphate of copper in sufficient quantity, and submitted to a second distillation in a smaller retort, by a water-bath. The liquid resulting from the second distillation should be agitated with rather more dry carbonate of potassium than it will dissolve, in a small tube provided with a stopper, and allowed to stand. A stratum of alcohol, if present, will, after a time, float on the surface, and may be drawn off by a pipette and examined.

Tests.—1. Alcohol has a hot pungent taste, a peculiar odour, and is very volatile. 2. Absorbed in asbestos, it burns with a pale blue flame, which deposits no carbon on white porcelain; and when burnt in the mouth of an inverted test-tube, containing a few drops of baryta, or lime-water, it produces a well-marked white deposit of carbonate of barium. Carbonic acid and water are the sole products of its combustion. 3. The liquid becomes green when boiled with a few drops of a solution of bichromate of potassium mixed with sulphuric acid. 4. The alcoholic liquid is made alkaline with a solution of potash or soda, warmed, and a solution of iodine in iodide of potassium is added until the liquid is brownish yellow; potash is again added till the liquid again becomes colourless. Sooner or later iodoform separates as a yellowy scaly precipitate; which, when examined under the microscope, is seen to consist of six-sided stars and rosettes.

The following method will allow of the detection of a quantity of alcohol too small for separation by the process above mentioned. Make a mixture of strong sulphuric acid and a saturated solution of bichromate of potassium: moisten with this mixture a few fibres of asbestos, and enclose them in a glass tube connected with the retort or flask in which distillation is carried on. For this purpose a flask or tube similar to those used for detection of chloroform vapour will be found serviceable. The smallest portion of alcohol-vapour passing over the asbestos, immediately renders it green, by converting the chromic acid into chromic chloride. This may serve as a trial test or for evidence, according to circumstances. The tube may be removed, and the condensed vapour collected for the application of the other tests. Ether and methyl alcohol produce a similar result.

From lapse of time, the effects of treatment, or absorption and elimination, there may be no trace of alcohol in the stomach or intestines, nevertheless the person may have died from the effects. In one case, fatal in eight hours, no alcohol was found in the stomach. One cause of failure may sometimes be traced to the distillation being restricted to a portion of the contents. It is advisable to distil the *whole*, as, if necessary, the distillate or the residue can be examined for other poisons.

Fusel oil is a volatile liquid of a pale yellow colour, lighter than water and only sparingly soluble in it. It is dissolved by alcohol and ether in all proportions, but not readily by chloroform. Water separates it from its ethereal solution. It has a hot burning taste and an offensive spirituous odour, which is very persistent and peculiar: by this it may be distinguished from other alcoholic liquids. It is inflammable, and burns with a pale bluish flame. Like alcohol, ether, and wood-spirit, it decomposes chromic acid, producing green chromic oxide. In organic mixtures ether might be used for its separation.

By distilling one part of fusel oil with two parts of acetate of potassium and one part of oil of vitriol, an ethereal liquid, amyl acetate, is produced, which is used in confectionery under the name of *Essence of Jargonelle Pear*. A child on two occasions became partially comatose and had livid lips and a feeble pulse, after eating some confectionery which it was calculated contained about one drop of this essence. Hence its use is not without danger (*Pharm. Jour.*, November, 1851, p. 214).

Methylated Spirit.—It is a very inflammable liquid, burning with a pale blue flame. It is light and volatile, readily in part separable from other liquids by distillation below 200° F. Its odour is peculiar. It mixes with water and alcohol in all proportions.

When *ether* has been taken as a liquid and has caused death, it may be separated from the contents of the stomach by the process described for alcohol. The chromic acid process (above) applied to the vapour during distillation will detect a minute quantity; and by its peculiar odour ether may be easily distinguished from alcohol or pyroxylic spirit. 1. Ether is highly inflammable, and burns with a yellow smoky flame, producing carbonic acid and water. 2. When shaken with an unequal bulk of water, only a small portion is dissolved, the rest floats on the surface. If taken in a liquid form, it may be separated from the contents of the stomach by distillation, and the product rectified by redistillation with dry carbonate of potassium at a temperature of about 120° F.

Cases.—The first is a fairly typical case of stupidity and foolishness leading to death :—

At an inquest held in May, 1904, the evidence showed that a Montgomeryshire farmer gave his son, aged four, whisky to drink, with the result that the child died in convulsions. The jury returned a verdict of death from alcoholic poisoning, and the father, who admitted that his children were frequently given beer and spirits at home, was censured.

A woman, æt. 41, drank straight off one and a half pints of whisky twenty-two overproof; she died in five and a quarter hours (*B. M. J.*, 1, 1895, p. 72).

Two pints of whisky caused death in eight hours in an adult (*Lancet*, 1, 1897, p. 1158).

A child, æt. 3, died comatose after a small tea-cup of whisky (*Lancet*, 2, 1899, p. 63), and a boy of six from three ounces of whisky was seized with spasms and died with a temperature of 105° F. (*ibid.*).

On poisoning by fusel oil, the following is taken from the *Lancet*, 2, 1901, p. 606:—

"Dr. Thomas B. Futcher, of Johns Hopkins University, records in the *New York Medical Journal* of August 3rd, two cases from the clinic of Professor Osler of the somewhat rare condition of poisoning by 'fusel oil,' an ingredient of crude spirits. The cases recorded in medical literature are very few. Dr. W. M. Ord reported a case at St. Thomas's Hospital in 1889 (*Lancet*, 2, 1889, p. 1225), and Dr. J. Swain (*B. M. J.*, 1, 1891, p. 903) recorded a fatal case at the Bristol Royal Infirmary in 1891. The two cases recorded by Dr. Futcher are as follows:—Case 1 was that of a woman, aged twenty-eight years, who was admitted to the Johns Hopkins Hospital at about midnight, complaining of general weakness. It was found that in company with a male (Case 2, *infra*) she had been drinking out of a six-ounce bottle of fusel oil during a debauch and was lying unconscious on the floor. At 9 a.m. next morning she had a headache, coated tongue, and a bad taste in the mouth, and suffered from general weakness. Her forehead was red from rubbing it, as she stated, with fusel oil a day earlier. There was a slight bronchitis. The pupils were normal in reaction, and an estimation of the blood showed 4,500,000 of red corpuscles and 7,000 leucocytes per cubic centimetre. The urine was of a pale yellow colour and slightly hazy, with a white precipitate, and exhaled 'a peculiar odour resembling violets.' There was a faint trace of albumen, and on testing with Fehling's solution sugar was found to be present. Tests with phenylhydrazine and with yeast confirmed the presence of sugar, but the polariscope showed that it was not glucose (dextrose), as the solution was lævo-rotatory. Next day the urine was free from sugar, but a trace of albumen persisted for a day or two longer. She was discharged as recovered after four days. Case 2 was that of a man, aged twenty-eight years, who was admitted into the hospital at the same time and under the same conditions as the above patient. His temperature was 100° F., the pulse was 120, and the respirations were forty-eight per minute. The right arm showed impairment of sensation and the right leg showed loss of power and an excessive knee-jerk. He gradually improved in hospital, though the muscular and sensory impairment persisted for four or five days. He was discharged on the sixth day. His urine had a dark brown 'smoky' appearance, with a 'peculiar aromatic fruity odour.' It gave the same chemical reaction for sugar as did the urine in the previous case, but was inactive to polarised light. Methæmoglobin was also present in the urine with a few broken-down red corpuscles. The sugar disappeared from the urine during the second day. The presence of sugar in both these cases was a peculiar and very rare feature."

Poisoning by Paraldehyde.

Source and Method of Occurrence.—This drug, of a very nauseous taste and strong odour, is now official, and its dose as a hypnotic is given as thirty to ninety minims. On its introduction it was thought to be an absolutely safe hypnotic; but no such thing does nor can in the nature of things exist. It was also thought that its nauseous taste would prevent anyone acquiring a habit of taking it; but this hope has likewise proved fallacious (*vide* a case fully reported by Dr. F. Ashby Elkins in the *Edin. Med. Jour.*, July, 1893).

Toxicity and Fatal Dose.—It must be admitted that its toxic powers are but feeble: thirteen drachms (*Lancet*, 2, 1900, p. 875) and three and a half ounces (*B. M. J.*, 2, 1891, p. 1254) have been given without fatal effect, but, on the other hand, two ounces have proved fatal (Westcott, "Extra Pharm.," 1904, p. 65).

Symptoms.—Vomiting, nausea and giddiness are the most prominent yet reported. In Dr. Elkins' case of habit the man's condition on admission was:—He was emaciated, anæmic, and had an exhausted harassed look. The tongue and facial muscles, and also the hands, were very tremulous, and, indeed, he was generally tremulous, like a case of delirium tremens. His gait was very feeble and unsteady, and all his movements were slow, like those of a very tired man. The heart's action was weak and irregular, the cardiac sounds being often difficult to hear, and the sequence of events difficult to follow. He complained of palpitation. The pulse was seventy-four per minute, and intermitted every 10–12 beats, and the volume of the beats was unequal. He complained of stomach derangement, especially of flatulence. The bowels were costive, the appetite was large, and he thought the paraldehyde increased it. He complained of strange feelings running through his body, some of which he described as "sort of shivers." He said he felt restless and nervous; and he was very anxious and, indeed, frightened about his condition. His breath smelt strongly of paraldehyde. He slept badly, had hallucinations, and was like a man in the early stage of delirium tremens.

Analysis.—*Vide* "Brit. Pharm." tests for the purity of the drug.

Cases.—In 1891, a supposed case of suicide by paraldehyde was communicated to Sir Thos. Stevenson by Bond. A lunatic, to whom this substance was being administered, managed to retain his nightly dose in the mouth and secrete it till he had obtained such a quantity of paraldehyde, as to cause fatal effects when taken in one dose.

Mackenzie was called to a patient who had taken three and a half ounces of paraldehyde. The breath smelt strongly of the liquid; the face was slightly flushed, the pupils moderately contracted, and quite insensible to light; the breathing and pulse were rapid, the skin warm. The woman was quite unconscious, and her body absolutely limp, like an anæsthetised person. She recovered (*B. M. J.*, 1891, 2, p. 1254).

The following is from the *Lancet*, 2, 1902, p. 673:—

A woman was ordered one drachm each of paraldehyde and syrup of orange-peel and water to one ounce; but by misadventure she was given an ounce of pure paraldehyde at 12 midnight, and the error was neither discovered nor even suspected until some seven hours afterwards. Upon being given the incorrect draught the patient struggled violently, and was with great difficulty made to swallow it. A quarter of an hour later the breathing became somewhat irregular and the patient's mouth and larynx full of a thick ropy mucus; the latter was all swabbed out and the breathing then greatly improved. As the patient was also suffering from bad stomatitis it was now thought that some of the draught (as ordered) had entered the lungs during the struggling when it was administered. At 1.15 a.m. the breathing was still rapid and irregular, thirty-two respirations to the minute, but the pulse was fairly strong (114); the patient, however, half choked with mucus, was becoming somewhat cyanosed, and the tongue was very red and swollen. The mouth was again swabbed out with relief. The patient was now semi-conscious, fairly sensitive to pain, but made no voluntary movement. However, she was easily roused by shouting, pinching, etc. The pupils were variable in size, but reacted both to light and to accommodation. At 2.15 a.m. she was given a hypodermic injection of three minims of liquor strychniæ with two minims of tincture of digitalis, which greatly improved both the respiration and cyanosis, but half an hour later the breathing again became rapid and irregular, with long inspiration and short expiration. The lips were pale and the mouth was dry and free from mucus. The pulse was regular (124), but the patient was quite unconscious. The pupils were contracted and the corneal reflexes were completely lost. At 3.30 a.m. the breathing was still shallow, more ropy mucus appeared in the mouth, the pulse was still 124, but the patient was more conscious and slightly sensitive to pain; at this time there was an involuntary slight action of the bowels. After this she became somewhat restless, tossing about and moaning occasionally; the pupils were dilated but not reacting to light. The pulse was good and the respirations were much quieter, continuing in this condition until 7.30 a.m., when she again became cyanosed, the pulse feeble and rapid, and the skin hot and dry, with very shallow respirations. At this period of the case the unfortunate mistake in the composition of the draught was discovered, but it was then deemed too late to give emetics or to wash out the stomach, so amyl nitrite was at once inhaled and five minims of liquor strychninæ were given hypodermically, followed by a hot coffee enema; these remedies greatly improved both the pulse and respiration, but the patient still remained somewhat cyanosed, with rapid and shallow breathing. She was then given diffusible stimulants in the shape of ammonia and ether, with brandy and hot water by the mouth, but as these were swallowed with difficulty brandy (twenty minims) was subcutaneously administered. For some hours she continued in a very drowsy state, the temperature reaching 100° F., with a pulse rate of 116 and a respiration rate of twenty-eight. Still being unable to swallow anything, she was given a nasal feed of eggs, milk-and-brandy, and a further hypodermic injection of strychnine. Later in the day she was able to swallow liquids, but at night the nasal feed and strychnine were repeated. In spite of this she continued to be drowsy throughout the following night, requiring more strychnine early in the morning of the second day, but after this she made rapid progress and was able to take plenty of nourishment by the mouth. The stupor gradually left her and in another twenty-four hours she had completely recovered from the evil effects of the undiluted paraldehyde.

Poisoning by Chloral Hydrate ($C\,Cl_3CH(OH)_2$).

Source and Method of Occurrence.—Chloral hydrate is a solid crystalline substance, produced by the reaction of chlorine on alcoholic liquids, and the subsequent addition of a small quantity of water. It has a peculiar hot nauseous smell and taste, which makes it very unsuitable for homicidal poisoning, though in beer it has been feloniously administered. It has been given in very large doses, often with benefit, but at other times causing dangerous symptoms, followed by death. Medical men who have taken it incautiously have died from its effects. Several instances of this kind are reported in the *Med. Times and Gaz.*, 1871, 1, p. 367. The deaths have been frequently sudden, and no remarkable symptoms have preceded dissolution. The person has passed from sleep into death. In 1891 there were seven deaths recorded in England and Wales from hydrate of chloral, and nine in 1900, of which eight were called accident or negligence—and from experience the editor is inclined to agree with this verdict.

Toxicity and Fatal Dose.—Chloral hydrate cannot be considered in itself to have a high degree of toxicity, but in diseased conditions of the heart it is a dangerous drug. Its deleterious action seems to be mainly exerted on the heart (*Lancet*, 1871, 1), but its hypnotic action is on the cortex cerebri. A view has been held that in the blood chloroform is evolved from it, but this is probably incorrect. Urochloral acid would seem to be the form in which it is eliminated by the kidneys (Mann).

Three grains in a child a year old is stated to have caused death ("Phil. Med. and Surg. Rep.," 1871). **Thirty grains** caused the death of a woman, æt. 30 (*Lancet*, 1871, 1, p. 226). A dose of thirty grains also proved fatal in thirty-five hours to a young lady, æt. 20. A man recovered from a dose of 160 grains taken at once (*Lancet*, 1870, 2, p. 402). Fuller states that one of his patients took 150 grains, and another 180 grains, without injury (*Lancet*, 1871, 1, p. 403; see also Husemann's *Jahresber.*, 1872, p. 509). Richardson states that the largest dose which he has known to be taken was 120 grains. It produced prolonged and dangerous coma, but recovery followed. He looks upon this as a safe dose for an adult, distributed over twenty-four hours in divided quantities. Taken at once it is a maximum dose for an adult, dangerous, but not necessarily fatal. Beyond 120 grains the danger increases, and 180 grains may be considered a dose that would prove, in the majority of cases, positively fatal (*Med. Times and Gaz.*, 1871, 1, p. 169). In one instance ninety grains introduced into the rectum produced rapidly insensibility, and caused death in three hours (*Lancet*, 1871, 2, p. 466). Recovery has taken place after a dose of 240 grains (*B. M. J.*, 1892, 2, p. 1055). Even larger doses may be taken by those who habituate themselves to the use of chloral.

There appears to be considerable uncertainty in the action of this drug, even when similar doses are given. After an ordinary dose of twenty or thirty grains a patient has slept for a quarter of an hour, and has then awakened with a sense of deadly faintness, the lips livid, the face pale, the pulse scarcely perceptible, and a feeling of intense exhaustion and impending dissolution, mingled with delirium, lasting for five or ten minutes. It appears to exert a depressing action on the heart, and in cases of heart-disease it may thus cause rapid death (*Lancet*, 1871, 2, p. 32). It is probable that it acts in what might be called a test manner on the heart, quickly affecting an unhealthy one and leaving a healthy one unaffected.

A syrup of chloral six grains in sixty minims is official, dose half to two drachms; this is the only official preparation.

Duration.—A patient may die in a few minutes, but more commonly survives for a few hours. Death has ensued so late as ten and even thirty-five hours. The symptoms of drowsiness appear in from ten minutes to half an hour; after this the patient sleeps, and may sleep several hours before death ensues.

Symptoms.—In the great majority of cases the only symptom is a quiet sleep which gradually deepens into coma and death. A lady took six doses of thirty grains each. She fell into a sound sleep. Every attempt failed to arouse her, and she slept into death. The principal post-mortem appearance was great congestion of the cerebral vessels (*Med. Times and Gaz.*, 1871, 1, p. 132). In another case a lady took, in three doses at intervals of four hours, seventy grains of the hydrate. In two hours after the last dose, she suffered from severe cramps in the legs, a feeling of suffocation, swimming in the head, and inability to regulate her movements. Four hours after the last dose her face was flushed, the eyelids were closed, and the conjunctivæ were injected; the pulse was quick (120) and bounding. She was with difficulty roused either to speak or take food. She recovered in about sixteen hours (*Med. Times and Gaz.*, 1870, 2, 435).

A patient took thirty grains of hydrate of chloral at night. He became unconscious almost immediately after swallowing the draught—the face and hands turned livid and cold, and breathing took place only at long intervals, indeed for about five hours death seemed to be impending. He recovered next day (*Lancet*, 1870, 2, p. 402). It has been observed, in reference to this drug, that in the sleep produced by it the pupil is contracted, but that it immediately dilates on the person awaking. In other cases the pupil has been dilated and insensible to light.

Cases of accidental poisoning by overdoses of chloral are very common. In these cases the fatal dose is rarely known. The usual symptoms are profound sleep, passing into coma. Breathing becomes gradually slower, till in the end it entirely ceases. The pulse becomes rapid, irregular, and weak. There is complete loss of sensation, with great muscular prostration; and the temperature falls much below the normal, and the patient often sweats profusely. It is probable that death usually takes place from paralysis of the heart. Sir Thos. Stevenson met with a case in which a young man barely survived a dose of seventy grains: he became idiotic, and never entirely recovered.

Treatment.—The stomach should be emptied by the tube or by an emetic. Warmth is of the utmost importance; it should be maintained by hot bottles, and the body should be surrounded by blankets, underneath which friction may be applied. Persistent attempts at rousing the patient should be made by means of the faradic current and other usual methods. If the breathing fails, artificial respiration should be performed. Hypodermic injections of strychnine (one-twenty-fifth of a grain) have been recommended, but strychnine is not so good an antidote to chloral hydrate as chloral hydrate is to strychnine (*vide* p. 338, false antagonism). Stimulants will probably be required: ether hypodermically, or alcohol by mouth or rectum. Hot coffee is useful (Mann).

Post-mortem Appearances.—There is nothing at all characteristic to be found on autopsy until analysis is applied. There may, however, be perceived the peculiar odour of chloral hydrate in the stomach contents.

Analysis.—Hydrate of chloral is a white, brittle, crystalline solid, of a peculiar odour and a pungent bitter taste. When heated on platinum it melts, and is entirely volatilised without combustion. It is not inflammable. Heated in a close tube, it melts, and does not rapidly solidify. It is distilled over in a liquid form, and after a time it sets into groups of crystals. It is soluble in water, which retains it on cooling. The solution is not acid, has no bleaching properties, and gives only a faint milkiness on boiling with a solution of nitrate of silver. It is dissolved by strong sulphuric and nitric acids, without any change of colour. Potash added to the solution converts it into chloroform, and into formic acid, which combines with the alkali. On boiling it with potash the solution, if the hydrate is pure, acquires only a slight yellow colour. When boiled with auric chloride or nitrate of silver, and alcoholic solution of soda is added, gold or silver is immediately precipitated. It decomposes a copper salt like grape-sugar, but in the cold potash does not redissolve the precipitated cupric hydrate.

One hundred parts will yield eighty-two parts of chloroform. It is by this conversion that hydrate of chloral may be detected in the contents of the stomach. The liquid should be rendered alkaline with potash, and the mixture heated in a flask by a water-bath. The vapour which escapes may be tested for chloroform by the process described on p. 583.

The quantity of hydrate of chloral present in a strong solution—*e.g.*, a draught—may be approximately determined by placing a measured quantity of the solution in a graduated and stoppered burette, and shaking with a solution of soda. On allowing the mixture to stand the chloroform formed by the decomposition of the hydrate of chloral will form a dense layer at the bottom. Approximately each minim of chloroform separated represents two grains of hydrate of chloral. By adding a solution of soda of known strength to a definite volume of a solution of chloral, and, when the chloral is decomposed, titrating the uncombined soda, the percentage of chloral in a dilute solution may be determined. A hundred grains of the hydrate when distilled with lime yield seventy grains of chloroform.

The most delicate test for chloral hydrate seems to be that with ammonium sulphide, which is thus described by Luff:—

"If to a solution of chloral hydrate a few drops of ammonium sulphide be added, the mixture either quickly or in a short time, according to the amount of chloral hydrate present, becomes opalescent, and finally acquires a yellowish or reddish yellow appearance, an amorphous precipitate finally settling to the bottom of the tube; at the same time a peculiar odour is developed. This test is an extremely delicate one."

Cases.—In 1889, a man was convicted of murder by the administration of hydrate of chloral in beer to an elderly gentleman (Manchester Spring Ass., *R.* v. *Pardon*). Insensibility quickly supervened, and within a few minutes of the victim being found insensible in a cab he died. Chloral was detected in the stomach of the deceased, but no attempt was made to estimate the quantity (*B. M. J.*, 1889, 2, p. 235). In 1891, a man was accused of murdering his wife by the administration of hydrate of chloral; but he was acquitted, there being no evidence that it was not a case of suicide. Sir Thos. Stevenson found six grains of the hydrate in the stomach and its contents (*R.* v. *Wynne*, C. C. C., October, 1891).

On June 1st, 1904, Mr. Drew held an inquest on a maiden lady forty-three, who had taken an overdose of chloral, quantity unknown. She was found dead after an interval of about twelve hours.

POISONING BY CHLORALOSE.

Source and Method of Occurrence.—This drug is formed by the action of chloral on glucose ("Extra Pharm."), and is supposed to be much safer as a hypnotic than chloral hydrate, but ill effects have followed its use, especially in large doses. A dose of twenty centigrammes caused very unpleasant symptoms (*Lancet*, 2, 1895, p. 684), and also eight grains have done so (*Lancet*, 2, 1900, p. 1803). *Vide* also Professor Bradbury's "Croonian Lecture," 1899.

Cases.—Dr. G. H. Lang records the following case in the *B. M. J.*, 1894, p. 233:—

"I found the patient, a middle-aged woman, lying in bed in a semi-comatose condition. She showed signs of irritation on attempts being made to wake her, but she could not be roused sufficiently to give an intelligible answer to any question. The face was congested and bluish, pupils equal and somewhat dilated, breathing normal, pulse sixty, regular, fairly full, and of high tension, skin warm and moist. On a table by the bed were a box which had contained cachets of chloralose (0·20 grammes in each), but was now empty, and a bottle of syrup of chloral, from which about ℥ vj. were missing. I concluded that she was suffering from poisoning by chloralose or chloral or both.

"As it appeared that the amount taken might be large, I proceeded to wash out the stomach. The water returned almost clear and without smell. I gave an enema of hot coffee. Soon after this she became sufficiently conscious to tell me that she had taken only three cachets, and that she had often taken two, and on more than one occasion three, cachets without ill effects.

"On visiting her later I found her quite well except for a slight headache. She told me that she had taken hypnotics for many years. Once before she had suffered from a very large dose of choralose, but quickly recovered after an emetic. On the present occasion she had taken two cachets at 1 a.m. and a third about an hour later. I saw her at 4.30 a.m. She thought she slept for a short time after taking the cachets, then felt very ill in an indefinite way, tried to open the door, which was locked, but fell down and was found there in an unconscious condition.

"The chloralose which she was in the habit of taking was made by Bain & Fournier, of Paris, but she had recently obtained a fresh supply from another firm, and two of the cachets taken were from this consignment. The contents of one of them weighed between grs. iij. and grs. iijss., that is, about 0·20 grammes.

"There is nothing in the symptoms to call for remark. They were sufficiently grave to call for active treatment. The quantity taken—0·60 grammes (grs. x.)—is the full dose recommended, but she had previously taken as much without ill effects. The untoward symptoms may have been due to rapid absorption from the empty stomach or to impurity in the new supply."

The following appears in the *Lancet*, 2, 1900, p. 1803, reported by Dr. Douty:—

"I was called at about twelve midnight to a young woman who was supposed to be in a fit. She had gone to bed at 11 p.m. She had been in the habit of indulging in chloral and also in cocaine at home, but she had taken very little while at Davos. A physician in London had given her cachets of chloralose, eight grains in each, to take for sleeplessness. She took one for the first time that night. I found her in great distress, unable to move her legs or her arms, with a feeling of numbness in them, the numbness being more marked on the right side. She could not move. Her mind was clear, but her speech was slow. Her pulse was good. She recovered in five or six hours. A week afterwards she took another cachet, and I was called at about 1 a.m. by her friend, who slept in her room, because she would not answer when spoken to and again was thought to be in a fit. She was in a cramped-up posture of emprosthotonos, her thighs were tightly flexed on her abdomen, and her chin was forced down on her chest. Respiration was almost inappreciable and very slow, and she was cyanosed. Her pulse was eighty and fairly good. Her extremities were not cold. She was quite unconscious, and I could not rouse her. I had difficulty in overcoming the contraction of her limbs and neck, but having done so, I performed artificial respiration for half an hour, whilst others applied very hot water to her chest and head, and as soon as she could swallow we forced down some brandy, and her breathing improved, but was very slow. In an hour it was possible to get a grunt in reply to questions. She remained in that state for six hours, and was torpid all the next day, then seemed quite herself again. The small extent to which the heart seemed affected on each occasion quite bore out Professor Bradbury's observations in his experiments."

POISONING BY SULPHONAL, DIMETHYL-METHANE-DIETHYL-SULPHONE.

Source and Method of Occurrence.—It is produced by the oxidation of a mixture of ethyl mercaptan and acetone ("Extra Pharm.," 1904). It is now official, and its dose is given as ten to thirty grains. It is supposed to be a very safe hypnotic, but accidents have occurred from its administration, and the habit of taking it may be acquired. No case of its homicidal use is yet recorded, nor does it seem a likely poison for a murderer or ill-disposed person.

Toxicity and Fatal Dose.—In the *Lancet*, 1, 1904, p. 219, a case of recovery after 365 grains is reported, so that its toxicity is decidedly slight. The editor met with a case in 1904 in which about eighty grains decidedly hastened death, though it is doubtful if it actually caused it. Dr. Maidlow reported to the editor a case in which "a dipsomaniac, with a mixed motive of suicide and a desire to sleep after an outbreak, twice took 125 grains in ten minutes, the only result being slight stupor and weakness of the legs."

B. M. J., 1, 1895, p. 698, recovery after between five and six grammes; *Lancet*, 1, 1909, p. 811, death from twenty grains.

Symptoms.—Sulphonal would seem to have an especial tendency to upset the renal function. It may apparently produce ischuria, oliguria, albuminuria, and hæmatoporphyrinuria (*B. M. J.*, Epit., 1, 1893, p. 23; also *Lancet*, 1, 1904, p. 564), but when it has given rise to more serious symptoms they have commonly been of a cardio-depressant or nervous ataxic type, of which the following, reported by Dr. Tresilian, of Enfield (*Med. Times*, 3, 1900, p. 73), is a good example:—

Mrs. X., aged twenty-eight, a hysterical patient, consulted him for insomnia. Twenty grains of sulphonal were ordered to be taken at night in hot spirit and water. This dose secured a good night's rest, but she was still irritable and excitable on the following day, and the next night could not sleep, so repeated the sulphonal, but only in a dose of fifteen grains. She again slept well, but the next morning was ataxic, and reeled about, and had headache and tinnitus aurium. At 2 p.m. she suddenly said she felt she was dying, and became cyanosed. Dr. Tresilian saw her at 2.30 p.m. She was then livid generally, the face most so. She could not speak. She had fainted and vomited two or three times. There was no dyspnœa; the respirations were extremely slow and shallow, the thoracic walls scarcely moving in respiration. Now and then she gave a slight sigh. The heart's action was feeble, and occasionally intermittent. The pupils were dilated and acted very feebly to light. Complaint was made of bad headache and noises in the head. Stimulants were administered, and hot-water bottles packed round the patient. Two injections of strychnine one-twenty-third and one-thirtieth of a grain were given within a few hours of each other, also mixture of ether, ammonia, and strophanthus. By the end of the day the patient was little, if any, better. There was retention of urine, which was relieved by the catheter; the water was dark-coloured. The heaviness and drowsiness continued.

The same treatment was continued, and the next day she was better—only vomited once and only slight diarrhœa. The cyanosis was lessening; plantar reflex was found deficient; knee jerk normal; headache bad, but the noise in the ear better. Gradual improvement took place, and in a few days she was well again.

In sulphonal habit disturbances of the digestive and nervous system occur.

In the *B. M. J.*, Epit., 1894, the following paragraph occurs, showing, or rather tending to show—for the evidence seems to the editor by no means conclusive—that sulphonal may fatally affect the kidneys:—

"Stern (*Deut. Med. Woch.*, March 8th, 1894) discusses the renal lesions in this condition. An insane woman, aged seventy, received one gramme of sulphonal every evening, the dose having to be doubled in a month's time. This was continued for more than three months, with frequent intermissions, amounting often to eight days. When the total amount taken was some 151 grammes the urine showed a dark colour due to hæmatoporphyrin. The drug was omitted at once. Fatal coma, however, supervened in a week's time. The kidneys were of a pale red colour, with smooth surface, and contained deposits of lime salts. These changes were such as might be attributed to advanced age, but the microscope displayed a very extensive necrosis of epithelium, and also minute hæmorrhages. These minute changes represented a toxic nephritis, and were unquestionably due to the sulphonal.

There was a large gall stone in the gall bladder, and small friable concretions in the scarred cystic duct. Very slight jaundice was present during life. The poisoning occurred here, as in other published cases, in a woman, and after the prolonged use of the drug. The obstinate constipation, the age of the patient, and the changes found in the myocardium, no doubt accelerated the result. During the use of sulphonal the urine should be carefully examined for albumen or formed elements, as when once hæmatoporphyrinuria appears the prognosis is unfavourable. In the presence of renal disease the prolonged use of sulphonal should be had recourse to with great caution."

The following fatal ending to the sulphonal habit is from the *Lancet*, 2, 1900, p. 269:—

"Dr. A. E. Taylor and Dr. J. Sailer have published an interesting case in the volume of 'Contributions from the William Pepper Laboratory of Clinical Medicine, University of Pennsylvania,' just issued, illustrating a somewhat rare condition resulting from the habit of taking sulphonal.

"The case was that of a woman, aged fifty-two years, unmarried, and presenting symptoms of hysteria. On inquiry it was discovered that she had been in the habit of taking sulphonal for some time, the dose being fifteen grains per diem. She was informed of the evil results likely to follow the continued use of the drug, and she discontinued its use for some weeks. After this she resumed taking the drug and began speedily to exhibit all the symptoms of sulphonal poisoning—viz., mental confusion, marked insomnia, difficulty of speech, and a peculiar sighing dyspnœa. The urine was tinged a deep pink colour (hæmatoporphyrinuria), and a stiffness and paralysis of both legs soon developed. The control of the sphincters was lost. Cutaneous sensibility was not affected. The paralysis spread rapidly upwards, and death resulted from cardiac failure. Spectroscopic examination of both urine and blood disclosed the presence of hæmotoporphyrin. At the necropsy the following conditions were revealed: Fatty degeneration was present in the heart, liver, and kidneys. The spleen was filled with a greenish pigment, both free and within the lymphoid corpuscles, the fibrous trabeculæ were greatly increased in size, and the lymphoid follicles were extremely well developed. Excessive pigmentation was found also in the lymphatic glands of the body and in the lungs. No notable morbid changes could be found in the spinal cord or brain.

"Cases of sulphonal poisoning are rare, and a case like the above in which the necropsy disclosed lesions of a characteristic nature in the various viscera of the body is rarer still, and possesses much importance both from a diagnostic and pathological standpoint. It is interesting to note, however, that hæmatoporphyrinuria—an indication of serious alterations taking place in the blood—from the use of sulphonal is nowadays less frequent than in the earlier days of the use of sulphonal, when the drug was not always obtained in a state of purity."

Treatment.—The stomach should be washed out on the chance of removing some of the material not yet absorbed, after which treatment must be on general stimulant lines, strychnine, hot coffee, etc. (*vide* p. 334).

Post-mortem Appearances.—All that is known is recorded above. *Vide* also Dr. Gulland's case below. The editor would add that in 1909 he had a case of hæmatoporphyrinuria under his care in the London Hospital, in which there was no evidence of the taking of any drug to cause it.

Analysis.—If a little dry sulphonal is heated in a test-tube with charcoal or iron in powder, the odour of mercaptan is given off; if iron is used, the subsequent addition of hydrochloric acid to the residue liberates sulphuretted hydrogen. If a little dry sulphonal is melted, and the heat is continued until the clear liquid boils, the addition of pyrogallol produces a brown colour with evolution of mercaptan (Mann). *Vide* also B. P. (1898) tests for the purity of the drug.

Cases.—In 1889, Sir Thos. Stevenson was consulted in a case of sulphonal poisoning, which occurred in the practice of Blatherwick. A lady, æt. 40, a dipsomaniac, took a dose of sulphonal, estimated at forty or fifty grains. She was seen twelve hours later, when her condition was as follows: extreme drowsiness, awakened with difficulty, and soon relapsing into somnolence; surface pale and ashen in hue; limbs flaccid, with great loss of muscular power; eyelids closed; pupils moderate in size and acting slowly to light; pulse 120, small; respiration quick, shallow, and at times almost imperceptible; tongue coated, no vomiting; very offensive odour of body and breath. No urine was passed for twenty-four hours, when it was drawn off, but no sulphonal could be detected in it. The patient was with difficulty made to swallow, and retained fluids in the mouth. She could be made to speak slowly, and with slurring of the words. She recovered in forty-eight hours.

Dillingham has also recorded a case of poisoning by sulphonal. An elderly woman took ninety grains by mistake one evening. At 3 a.m. she was found in a semi-comatose state, which quickly passed into stupor with stertorous breathing. The pulse was almost imperceptible, and the extremities cold. There was well-marked want of control over the muscles, the face was drawn to the right side, and the right eyelid dropped. Pupils normal. She would doze for a few minutes, and then open her eyes, but recognise no one. Urine normal. She recovered under treatment, but the partial paralysis of the face and want of control over the muscles continued for ten days (*Med. Record*, December 13th, 1890).

Sixty grains produced very serious symptoms (*B. M. J.*, 2, 1898, p. 808); and 120 grains caused a patient to become very cold and livid, and the pupils to become fixed and dilated (*Ibid.*, p. 1337).

At a meeting of the Liverpool Medical Association, December, 1898, Dr. G. Lovell Gulland read a paper in which he narrated a fatal case where the patient had, without the knowledge of his medical advisor, taken thirty grains of sulphonal every night for about six weeks. About a week before his death he developed ataxia of the extremities, lassitude and drowsiness, and then hæmatoporphyrinuria, and died somewhat suddenly. The post-mortem examination showed no very marked gross lesions beyond fatty degeneration of the heart and stasis in all the organs, but when these were examined microscopically the principal change was found to be necrosis of the secreting epithelium of the kidney, and certain degenerations in the liver and suprarenal capsules. Dr. Gulland proceeded to discuss the clinical history of chronic sulphonal poisoning, and to point out the differences between this and, on the one hand, the temporary by-effects after a single medicinal dose of the drug, and on the other the symptoms of acute poisoning from a large single dose. The pathology of both acute and chronic poisoning was described, and special stress was laid on the kidney changes which were common to both chronic and acute forms, and which the author believed to have at least as much to do with the fatal issue as the action of the drug as a blood poison. In regard to the treatment of acute poisoning, it was pointed out that it was essential to remove as much as possible of the insoluble drug from the alimentary tract, and also to keep up free diuresis, whilst in the chronic form the free use of alkalies was insisted on. The paper terminated with a discussion of the cases in which sulphonal should not be given, these being especially cases where there was constipation, great prostration, or kidney disease, and with a plea for the more careful and discriminating use of the drug (*B. M. J.*, 2, 1898, p. 1821).

The following is a curious case, and certainly suggests that sulphonal cannot be very dangerous:—

"A married woman, aged thirty-seven, separated from her husband owing to her habits of intemperance, had been abstemious under restraint for about three months, when on May 24th, 1895, she showed signs of an approaching attack of alcoholism. She was watched carefully for a time, but, owing to illness and removal of her attendant, she was left in charge of a maid. Her first dose on June 1st was about one pint and a half of methylated spirit, partly procured from a lamp in the house; then twopennyworth of the same was obtained from a lamp shop (about six ounces), the druggists in the district having received notice not to serve her. Thereupon her thirst seemed to be so extreme that she resorted to some

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painters, from whose can of turpentine she took a drink. She next discovered a bottle containing 100 tabloids of sulphonal, containing five grains in each, which had previously been taken from her, and which she had received by post; these she chewed up in her mouth one after another till she had swallowed fifty-three (equal to 265 grains). About 5 p.m. the same day she was found by the maid (who had unfortunately been obliged, owing to domestic duties, to leave her a great deal to herself) in a state of stupor on the floor, and was carried to bed. At 11.15 p.m. I was summoned to her and found her sleeping on her side with her knees drawn up, and the pupils slightly contracted and insensible to light. When roused she smiled graciously and lapsed off to sleep again; she tried once to raise herself in bed, when she fell powerlessly back again. Next day the legs were found to be extended, and the soles of the feet were arched in a state of extreme flexion. The bowels were confined. She slept from 5 p.m. on June 1st till 5 a.m. on the 4th—sixty hours—and did not regain speech till the 7th and the power of locomotion till the 9th. This case is interesting as showing the irritation produced to the plantar branches of the post-tibial nerve, presumably by the sulphonal, and the long period that elapsed before the toxic flexion of the soles made itself manifest, thus showing the slowness of the action of the drug."

The following is from the *B. M. J.*, Epit., 2, 1898, p. 332 :—

"Wien (*Berl. Klin. Woch.*, September 26th, 1898) relates a fatal case of subacute poisoning in a woman, aged thirty-two, suffering from paranoia. The patient received three doses, each of 0·5 gram, at intervals of an hour and a half, on each of thirty-one days, with occasional intermissions. The urine was examined daily, and the patient had been treated previously with about the same doses with no ill effect. When the sulphonal was discontinued the patient had become quiet, but this was not the result of any sulphonal narcosis. Her general condition was good. Thirty-six hours later the symptoms of sulphonal poisoning appeared. They consisted at first of gastric symptoms, with pain and vomiting, and later paralysis and hæmatoporphyrinuria were noted. It appears to the author probable that the poisoning was due to a cumulative action. Besides the ataxia there was paralysis in the arms and legs, probably due to a peripheral lesion. A notable fact in this case was the late appearance of the hæmatoporphyrinuria, which occurred eight days after the onset of the intoxication symptoms. Albuminuria and other evidence of a toxic nephritis appeared later. The pulse-rate fell towards the end to sixty-eight as a result of changes in the myocardium. At the necropsy a toxic nephritis and cystitis were found. The heart muscle showed degenerative changes, and the pericardial sac contained an excess of fluid. The author maintains that the great danger in sulphonal poisoning lies in the irreparable changes found in the heart. In the stomach there were small hæmorrhagic erosions, and the organ presented an hour-glass contraction due to old ulceration. Nine-tenths of the cases of fatal sulphonal poisoning have occurred in women. Although the number of cases of poisoning by sulphonal is small considering the frequency with which it is used, yet precautions must be taken. The use of this agent must be as limited as possible, and intermissions of even four or five days are too short. The author thinks that when symptoms of poisoning have already appeared, transfusion, or, failing that, infusion, of saline solution should be tried. Camphor should be used in case of the least threatening of cardiac failure. Efforts should be made to promote the excretion of the sulphonal by diuresis, etc."

POISONING BY TRIONAL, DIETHYLMETHANE-DIETHYL-SULPHONE.

The editor is unable to find a fatal case of trional poisoning, but the following shows its danger :—

"Dr. Warren Coleman, of New York, records in the *Medical News* of July 28th, 1900, a rare and interesting case of acute poisoning by trional. The symptoms of poisoning by this drug have been said to consist of vertigo, loss of equilibration, ataxia, nausea and vomiting, diarrhœa, stortorous breathing and cyanosis, tinnitus aurium, hallucinations, and hæmatoporphyrinuria. The case recorded by Dr. Coleman is that of a woman, aged thirty-five years, who was suffering from a mild delirium brought on by an excessive indulgence in champagne and alcoholic drinks for several days. Six trional powders (of fifteen grains each) were ordered to be taken, one every half-hour for two hours. The patient became drowsy and sleepy, and on the third day it was found difficult to rouse her. There were no disturbances of respiration or circulation to be detected by ordinary clinical examination. In answer to questions she replied that she was 'dizzy and sleepy.' Her speech was thick, and she walked with difficulty, the gait being ataxic. She showed no sensory disturbances, and the urine was free from hæmatoporphyrin. Upon inquiry it appeared that she had taken trional far in excess of the prescription and to the extent of nine drachms (540 grains) in seventy-two hours, the original prescription having been repeatedly made up at the stores. The patient was ordered a saline purge, and she gradually recovered from her state of trional intoxication. The above case shows that trional is free from excessive depressing effects even when taken in maximal medicinal doses, and that even when by accident enormous doses are taken the result need not be necessarily fatal. The development of hæmatoporphyrinuria should always be looked upon as a danger signal in cases of administration of trional or sulphonal, and the use of the drug should be discontinued until this symptom has passed away. Attention may be here recalled to a case of the sulphonal habit ending fatally which was recently recorded in these columns" (*Lancet*, 2, 1900, p. 751).

And in the *Lancet*, 1, 1903, p. 1096, is recorded recovery from 125 grains.

POISONING BY BROMOFORM ($CHBr_3$).

Source and Method of Occurrence.—Bromoform is the bromine analogue of chloroform; it is a colourless, sweet liquid, gaining a great reputation as a sedative in whooping cough, but has all the same to be given with care. It is only slightly soluble in water, and hence not infrequently the last dose in a bottle contains a poisonous dose.

Cases.—An inquest was held at Lancaster concerning the death of a little girl five years old, the daughter of the infirmary porter. It seems that thirty-six minims of bromoform were put in a mixture made up with mucilage and water, and the child died after the last dose had been taken. The theory was that the whole of the bromoform had been left at the bottom of the bottle and taken in the last dose from its not having been shaken, as directed. The report is rather meagre, and, as this is said to be the first recorded case of bromoform poisoning, it would be well if a fuller account were given (*Lancet*, 2, 1898, p. 1816).

The following is reported in the *Lancet*, 1, 1899, p. 119, by Dr. Evans:—

In the early part of last year my partner's five children were suffering from pertussis, and, other remedies failing, he decided to try bromoform, one and a half drachms of which were put in a mixture made up to eight ounces with mucilage and water. The eldest girl, aged eight years, took one tablespoonful, and the others smaller doses according to their ages. For four or five days they took the medicine, and were so benefited by it that it was discontinued. On the sixth day, about 4.30 p.m., I was sent for, as my partner was out, and on arriving I found the eldest girl in the following critical condition. She was lying in a wholly unconscious state, snoring deeply. Both pupils were strongly contracted, and hardly reacted to light. The conjunctival reflexes were almost lost, the pulse at the wrist was scarcely perceptible, and the heart-sounds were very weak. The face was pinched, and the lips were blue. I gave two drachms of ipecacuanha wine, which produced fairly free vomiting, and followed this up by a hypodermic injection of $\frac{1}{120}$th of a grain of strychnine, and applied hot flannels over the heart. As the improvement in the child's condition was very slight, I gave an injection of two drachms of whisky under the skin of the chest and an enema of strong coffee. The pupils were now more dilated, and the pulse was better in strength and quality; and though still unconscious, the patient's general condition had improved. Her father then returned and drew my attention to a peculiar sweetish smell which was evolved from the vomit and breath, and on inquiry we received the following particulars of the onset from the mother. The girl had a violent fit of coughing at 3 p.m., and was given a dose of the bromoform mixture, the last in the bottle. She then lay down. From half to three-quarters of an hour later her mother heard loud snoring issuing from the room, and, being unable to rouse the child, sent for me. About 8 p.m. the patient recognised her father and seemed to be improving. At 10 p.m. there was a change for the worse; the character of the respiration, however, changed from the loud snoring to a soft sighing, becoming so feeble that we resorted to artificial respiration. Owing to the recurrence of the symptoms, we suspected that some of the drug must be left in the stomach, which we accordingly washed out with an ordinary syphon pump, and noticed that the water which returned had the same sweetish smell, which smell the child's breath retained for several days. The remaining treatment through the night consisted in putting the patient near an open window, where she gradually recovered, and, with the exception of a very bad headache the next day, she did not seem much the worse for her misadventure.

The next two from the *B. M. J.*, 1, 1900, p. 1283:—

"A number of children in the same house, and of nearly the same age, were being treated by me for whooping cough with half-minim doses of bromoform three times a day, suspended in a mucilage of tragacanth. When called to two of the children about 12.30 p.m. I found them unconscious, lying side by side, with breath smelling strongly of bromoform, with faces pale, eyes closed, pupils contracted, and limbs flaccid. The respiration was feeble in the elder child (aged four) and stertorous in the younger (aged two). About 12.40 p.m. respiration ceased in the younger child, and artificial respiration was resorted to, and a few minutes later artificial respiration had to be resorted to for the elder. I gave each of the children about half a teaspoonful of brandy hypodermically, and then three injections of strychnine each at intervals of fifteen minutes, to the elder a two-hundredth of a grain and to the younger a four-hundredth of a grain each time. I thoroughly washed out their stomachs two or three times with hot water, followed by strong coffee, some of the latter being allowed to remain in the stomach. The younger child rallied first, and began to breath spontaneously after an hour and a half's artificial respiration. The interval was about the same in the case of the older child, but he remained drowsy and stupid for some hours. According to the nurse's account, the children had their doses about 8 a.m., but these were the last in the bottle. Shortly after this they were put to bed, and on being awakened at 11 a.m. they were giddy and confused, and staggered in their gait. From this time onwards the symptoms gradually developed until 12.30 p.m., when I arrived.

"The bromoform must have accumulated at the bottom of the bottle through its not having been properly shaken up each time; but even on this hypothesis it is hard to see how the children could have had more than three or four minims each of pure bromoform in a dose of a teaspoonful."

A further non-fatal case is to be found in the *B. M. J.*, 1, 1901, p. 1202. In this case one drachm of bromoform was put in a four-ounce mixture, and it was again the last two-drachm dose that proved mischievous.

The editor feels that the substance cannot be looked upon as very poisonous, though the doses recorded are, in a sense, all very small.

Analysis.—If necessary, bromoform can be tested by similar methods to those used for chloroform (*q.v.* p. 583).

POISONING BY ACETANILIDE OR ANTIFEBRIN.

Source and Method of Occurrence.—This drug is a direct aniline derivative, and is now official in doses of one to three grains. This was formerly three to ten, but in consequence of the numerous cases of unpleasant results was reduced as above to one to three. It is antipyretic in its action. It is by no means free from risk, though actual death from its use is not common. Hitherto those that have occurred have been either accidental or due to carelessness. Toxic symptoms have frequently followed its administration even in medical doses, and cases of fatal poisoning are not very rare. The first occurred in 1896 (*Pharm. Jour.*, 2, 1896, p. 14).

Toxicity and Fatal Dose.—Aniline seems to hand on to all its derivatives (the same power would seem also to reside in sulphonal and other modern synthetical drugs), the power which itself possesses to destroy the red corpuscles of the blood and decompose the hæmoglobin, with the result of producing hæmatoporphyrin; this appears in the urine. Either this substance is poisonous to the kidneys or else the drugs have a special evil influence on kidney epithelium (*vide* below).

Judged by the first fatal case, the lethal dose may be somewhere **between five and eleven grains.**

Symptoms.—These are well described by Dr. Philip King Brown in the *American Journal of the Medical Sciences* for December. A man, aged thirty-seven years, was given sixty grains of acetanilide in six powders for headache, and he took them all within a few hours. When seen by his medical attendant (after what interval of time is not stated) he was slightly delirious and complained of pain in the head and in the left umbilical region. There were pyrexia, rapid heart, marked constipation, slight jaundice, nausea, and vomiting. Calomel in small doses followed by salts produced a copious but bloody motion and the urine was dark red. On the following day he was admitted to hospital. The pulse was seventy-eight, soft and compressible; the temperature was 100·2° F.; the lips and nails were extremely cyanotic; and there was slight jaundice. He complained of pain in the left side of the abdomen and there was tenderness in the epigastrium and in the region of the left kidney. The skin was moist and the gums were bluish. The urine was strongly alkaline and deep red—nearly black. The colour was shown to be due to hæmatoporphyrin. There was a small sediment which contained granular casts. On boiling, a large coagulum formed. On the day after admission only 150 cubic centimeters of urine were passed; after this there was complete suppression. There was great thirst, which was quenched with milk, but soon everything that was given was rejected and rectal feeding had to be adopted. Though nothing was given by the mouth for days the vomiting continued. Cough and expectoration were persistent. There was slight delirium and the reaction of the pupils to light became more and more sluggish; in the end the pupils were widely dilated. The reflexes were first exaggerated, then they gradually disappeared. The extremities were constantly cold. The temperature fell slowly to normal on the fourth day and was subsequently subnormal, reaching 95·5° in the rectum on the evening before death, which took place on the eighth day of the illness. There was alternately constipation and diarrhœa, and forty-eight hours before death and twenty-seven hours after the suppression of urine blood-colouring matter and broken-down blood cells were constantly in the fæces, which previously were blood-stained only occasionally. The heart began to fail on the fourth day. The skin became more and more jaundiced. On the fifth day after admission mucous casts were passed. Examination of the blood showed destruction of the red corpuscles, which finally were reduced to 1,166,000 per cubic millimeter, while the leucocytes were 66,450 and the nucleated red cells 22,150. The alkalinity of the blood was diminished by eighty per cent. These blood-changes are easily explained on the above view of the action of the drug.

Treatment.—Empty the stomach and treat on general principles, oxygen might be tried.

Post-mortem Appearances.—At the necropsy on the above case acute nephritis and intestinal catarrh were found, but nothing to account for the melæna (*Lancet*, 1, 1902, p. 243). This nephritis is, however, not at all suggestive of poisoning by antifebrin, to which no characteristic appearances can yet be ascribed.

Analysis.—Antifebrin may be extracted from acid aqueous solution by ether or chloroform.

Sulpho-vanadic acid produces a brownish-red colour, which changes to dirty green. If a drop of a solution of potassium dichromate is mixed with a drop of strong sulphuric acid on a colour-slab, and a fragment of antifebrin added, a red colour which changes to brown, and then to dirty green is produced. Boiled with an aqueous solution of potash, antifebrin is decomposed into aniline and potassium acetate, which may be respectively recognised by appropriate tests. Antifebrin may be distinguished from antipyrin by the absence of reaction on the addition of ferric chloride (Mann).

An aqueous solution of antifebrin treated with bromine water gives a yellowish-white precipitate insoluble in dilute caustic potash, thus distinguishing it from a somewhat similar precipitate obtained with bromine water from aqueous solutions containing phenol or salicylic acid.

Cases.—The first fatal case occurred in 1896 (*Pharm. Jour.*, 2, 1896, p. 14).

The victim, Ada Waterhouse, æt. 22, took a "Daisy powder" at 1 p.m. Seen in less than five minutes, and then said that the headache for which she had taken the powder was worse, and said she felt as though she would go out of her mind. Screamed, went into a sort of fit, and said, "Hold me; I must be going to die." Was conscious at intervals when not convulsed. At 1.30 Dr. Chesnutt saw her. Then dying. Face very cyanosed. Artificial respiration brought back colour and improved respiration, slowing it and making it less laboured. Pulse very rapid, thready, and uncountable. Gave rational answers. Intense pain in legs. No convulsions from 1.30 to 1.45, when she was much better. But she died about 2 p.m., *i.e.*, in one hour. Convulsions unlike those of strychnine.

Mr. J. C. Loam, chemist, said he sold the powder, which was one of a consignment from Messrs. Ellis & Co., Holbeck New Mills, Leeds. He had had only one previous complaint. Dr. Chesnutt said there was no doubt in his mind that death was due to poison by the "Daisy powder." He had obtained similar powders from the same chemist and had analysed them in conjunction with the latter, and found it answer to the tests for antifebrin, and he found that the three powders all varied in weight, an evidence of gross negligence on the part of the dispenser. The certificate of Mr. J. J. Beynes, public analyst for the East Riding, was then put in. It confirmed generally the doctor's evidence. He had also purchased twenty-one powders and weighed them, and the weights varied from 4·60 to 10·89 grains, and that they consisted of pure acetanilide. From that it appeared that the powders were most variable in weight, and that great carelessness had been shown in weighing them. Verdict, "Death by misadventure."

In *B. M. J.*, 1, 1898, p. 1539, a death from two such "Daisy powders" is reported, and in the same journal, vol. 2, 1898, a discussion on the subject is published.

On January 25th, 1900, an inquest was held at Liverpool on a little girl, æt. 6 years 10 months, who died from taking a "Daisy powder." The directions were that she was to have half a powder, but by mistake took a whole one.

Dr. Baxter said he found the child breathing with great difficulty, with lips and skin very blue in appearance. He had no doubt the child died from paralysis of the centre of respiration, caused by taking too much of the powder. He did not think it was sufficiently stated that the powders were not for young children. In his opinion a whole powder would be sufficient to produce the death of a child of such age as the deceased.

Poisoning by Thalline.

Source and Method of Occurrence.—A body of similar origin and uses to antipyrine, and of similar danger. A case is recorded in which nine grains proved fatal ("Extra Pharm.," 1904, p. 196). The dose is said to be three to five grains.

Poisoning by Exalgine, or Methylacetanilide.

Source and Method of Occurrence.—This is another coal tar derivative used as an analgesic and sedative, it is not official, its dose is stated to be half to one or two grains and consequently it is distinctly a dangerous drug for the public to play with. Several cases have been recorded of unpleasant effects; for instance, eight grains caused fainting and sense of dying (*B. M. J.*, 1, 1899, p. 1518), and only five grains caused complete unconsciousness for three hours (*Lancet*, 1, 1895, p. 1307). The following case is reported in the *Lancet*, 2, 1899, p. 890, the patient took 150 grains as was afterwards ascertained:

A Chinese male adult was taken to the Government Civil Hospital, Hong-Kong, on July 31st, at 11 a.m., who stated that he had taken some medicine out of a tin purchased in the town, and this tin they produced. It was the usual one-ounce tin stamped with the words "Exalgine" and "Merck." The patient was quite unconscious, intensely livid, with pin-point pupils and a full bounding pulse. His temperature was 100·8° F. He had vomited once. He was given thirty grains of salicylic acid by the nasal tube and one-fiftieth of a grain of atropia hypodermically, and was put to bed. He remained in much the same condition, so two hours later he was given one-hundredth of a grain of atropia, with small quantities of milk and strong coffee. The urine was examined and contained one-fifteenth albumin. During the night he again had one-hundredth of a grain of atropia. Next morning he was out of danger though his colour and pupils were not quite normal, but the urine was now free from albumin. He was somewhat weak for several days and his temperature varied between normal and 100·8°, though this might have been due to the primary syphilis from which he was found to be suffering. He apparently purchased and took the medicine to open his bowels, though it was found impossible to ascertain why and where he bought it.

The case (*supra*) of symptoms from five grains was as follows:

A single woman, aged thirty, extremely thin, was under my care for severe asthma and consequent insomnia. On May 3rd of this year she was given by a friend, without my knowledge, five grains of exalgine. Within five minutes "she screamed out, becoming perfectly stiff." Twenty minutes later, when I saw her, she was profoundly unconscious, her respiration being very shallow and infrequent and rapidly failing. The lips and finger-tips were markedly cyanosed and the extremities were cold; the pupils were widely dilated and fixed; the knee-jerks were absent; the pulse was ninety-five, small and feeble. One-fifth of a grain of apomorphine was given at once, but failed to produce emesis. Free stimulation with brandy and coffee, vigorous flagellation, faradisation, and occasionally artificial respiration were employed for three hours, at the end of which time the cyanosis had nearly disappeared and respiration was fairly well established. The patient, when roused, was incoherent and failed to recognise her surroundings, rapidly relapsing into unconsciousness. About an hour afterwards there was an evident tendency to heart failure, the pulse dropping repeatedly below fifty and becoming irregular and feeble. Ether was given at regular intervals hypodermically. Nine hours after taking the drug the pulse and respiration were both good, the pupils reacted well, and the knee-jerks were present. No urine could be drawn off with a catheter. The next day the patient was perfectly well except for aphonia, which lasted for some hours. The points of interest in the case appear to be the rapidity of the onset of the toxic effects and the evident danger in giving even moderate doses of exalgine—a respiratory poison—to asthmatics.

POISONING BY ANTIPYRIN (PHENAZONUM).

Source and Method of Occurrence.—This is another coal tar derivative introduced into medicine for its power of reducing fever. It is a very powerful and dangerous drug, at any rate for self-administration, and numberless cases of unpleasant and even dangerous symptoms arising from its use have been recorded, and several deaths. It has not yet been used for homicidal purposes.

The drug itself is official as phenazonum, and its dose is given as five to twenty grains, but the editor feels that doses over ten grains are distinctly risky, he having met with very distressing trouble from a dose of ten grains only, though happily the case did not terminate fatally.

Iodo-, bromo-, ferri-, and sali-pyrin are non-official combinations of it; hypnal, pyramidon, and tussol are also fancy names for compounds of it.

Symptoms.—These vary materially in individual cases, but one common note runs through them all, viz., extreme collapse, coldness and depression of the heart's action. The following supplies a typical example. It is reported in a letter to the *B. M. J.* for 1896, vol. 1, p. 269. The editor can fully endorse Dr. Hayes' remarks at the end of his letter.

On January 18th, 1896, P. L. aged twenty-four, was suffering from "neuralgia" (self-diagnosed). On the advice of his brother-in-law, whose wife was under treatment for a nervous complaint, and who was taking fifteen grain doses of antipyrin, P. L. applied to a chemist for ten grains of antipyrin. This was taken in the shop at the time. Within a quarter of an hour after taking the dose the patient felt very ill. When I saw him shortly afterwards his face was cyanosed, his lips and nose swollen and blue, and his eyes almost closed from swelling of the eyelids. His skin was cold and clammy; he was sweating, and his pulse was 128, very weak, small, and compressible. The pupils were widely dilated. He was very much alarmed, and expressed himself as being in fear of impending death. He had been sick previous to my seeing him, but the vomited matter appeared to have been, from his description, simply a little mucus mixed with saliva. He walked to my consulting-room, distant nearly a mile from where the dose was taken. I at once administered a draught containing five grains of carbonate of ammonia, one-fiftieth of a grain of digitalin, one-fiftieth of a grain of strychnine, and half an ounce of vinum aurantii. I got him to lie down, and in the course of the next quarter of an hour his condition improved so far as the symptoms of cardiac depression were concerned. The pulse grew fuller and steadier, the feeling of faintness passed off, and he expressed himself as feeling better. He was still perspiring freely, and the pupils were moderately dilated. After resting for half an hour he went home, and I advised him to go to bed, and stay there for the next twenty-four hours.

In reporting this case I cannot too forcibly draw attention to the fact that antipyrin is a dangerous drug, and the careless and casual way in which patients are advised to take "an antipyrin powder" by utterly irresponsible persons cannot be too strongly condemned. I am sure it is not putting the case too strongly to say that antipyrin ought to be scheduled as a poison, only to be dispensed on a written order from a qualified and registered medical practitioner being produced. I would also beg to draw attention to the fact that by combining some preparation of ammonia (the spiritus ammon. aromat. answers very well) with antipyrin, the latter drug can be prescribed with less fear of unpleasant and alarming sequelæ than by using it alone. This may appear to be a small matter, but, bearing in mind that it is the fashion at present to prescribe almost every drug in "tabloid" form, it is worth remembering.

Vide also *B. M. J.*, Epit. 2, 1899, p. 7.

Analysis.—Antipyrin may be extracted by chloroform from both acid and alkaline solution, but it is preferable to alkalise before shaking out.

Tests.—With ferric chloride a dark-red colour is produced, which is destroyed by mineral acids in excess. When antipyrin is heated with a solution of bleaching-powder a brick-red precipitate is formed. If a little potassium nitrate is dissolved in water, and excess of strong sulphuric acid is added, the nitrous acid set free produces a green colour with antipyrin; this test is common to all pyrazolones. The urine from patients taking antipyrin yields the ferric chloride reaction on simple addition of the reagent. Antipyrin is precipitated by most of the alkaloidal group reagents (Mann).

Cases.—For a case of severe rash, etc., following antipyrin, *vide Lancet*, 1, 1897, p. 309.

POISONING BY PHENACETIN.

Source and Method of Occurrence.—This drug is another coal tar derivative with antipyretic and analgesic qualities; its official dose is five to ten grains; it is said to be free from unpleasant effects, but all the same three doses of eight grains each caused very alarming symptoms.

J. H., aged forty, on the morning of July 23rd, 1895, complained of neuralgic headache. He was ordered powders, which were subsequently ascertained to be phenacetin eight grains, every three hours. He took the third dose about 5 p.m., and shortly afterwards, while at his tea, he began to feel very ill; his wife noticed that his face was very pale. He was taken upstairs with difficulty and put to bed. When seen soon afterwards he was complaining of shivering, inspiratory dyspnœa, and profuse sweating from the forehead. The face was of a dark, almost mahogany colour, somewhat swollen; on the back of each hand was a wheal of similar colour, pyriform in shape, with the apex at the styloid process of the radius, and the base extending from the metacarpo-phalangeal joint of the thumb to that of the third finger. The shirt was thrown open at the neck, disclosing another wheal of much lighter colour on the right shoulder, about the size and shape of the palm of the hand. There were no wheals anywhere but on these exposed portions of the body. At intervals the patient had sudden jerking of the whole body. He was extremely anxious, and afraid that he was about to die.

The mercury would not rise in a thermometer graduated down to 95°; pulse very feeble, 100, regular. There was a systolic, mitral murmur, and sibilant and sonorous rhonchi all over the chest. The urine appeared on inspection to be normal.

The points of interest in the case were the distribution of the rash only on portions of the body exposed to the air, the extreme depression of the temperature, and the profuse perspiration from the forehead, with dryness of the rest of the skin. He was well next day (*B. M. J.*, 1, 1896, p. 146).

For another case, where seventy-five grains were not fatal, *vide B. M. J.*, 1, 1904, p. 545.

For **tests** for phenacetin *vide* Squires' "Comp. to Brit. Pharm.," 1899.

POISONING BY VERONAL.

Source and Method of Occurrence.—This drug is a urea derivative—diethyl-malonyl-urea, a white crystalline powder (extra Pharm.). It is a typical synthetic compound introduced as a soporific, said to be four times as powerful as sulphonal.

The following is the only recorded case of poisoning by it, but doubtless others will occur in future.

The patient was a woman, æt. 19, and Dr. Fernandez thus describes her symptoms:—

"On December 13th, 1903, I found her in what appeared to be a sound sleep. With some difficulty she could be roused, but relapsed immediately. The pupils reacted to light. As time went on the symptoms gradually subsided and by midnight I was able to learn from her that she had taken something to make her sleep, but of what character that something was she absolutely refused to tell me. It was not until the next morning that I became acquainted with the drug in question when I received from her husband a box of veronal cachets, each containing eight grains, which had been found in her room. I saw her again the same day, when she had apparently quite recovered, having slept soundly throughout the previous night. An erythematous rash appeared all over the body. There was a great amount of irritation of the skin, especially of the face, which presented a very swollen appearance. There was little or no elevation of temperature and the symptoms passed off in the course of three days with the aid of sedative lotions. On the 21st I was again called to see the patient, whom I found suffering from the following symptoms: tenderness in the right mastoid region with enlargement of the glands around; a thick ceruminous discharge from the right ear; a temperature of 100° F.; the tongue strawberry coloured and pointed; and a pulse of 125. She appeared to be in a very drowsy condition but assured me that she had not taken any more veronal. Refusing absolutely to take any form of liquid medicine I ordered her sulphate of quinine tabloids, each containing two grains, to be taken every three hours. This I did more as a 'placebo' than anything else. The next day, the 22nd, the patient had periodical attacks of delirium alternating with periods of semi-coma in which she lay on her back with her oyes half open. There was also a peculiar scarlatiniform rash over the face and arms; the bowels were obstinately confined. On the 23rd the patient was about the same. Fearing the symptoms might be due to some obscure brain lesion (due to a sun attack in Jersey) I called in further advice, but could not obtain any decided opinion. On the 24th the patient was still about the same, the temperature ranging from normal to 101°. Constipation was obstinate even after two enemata and half an ounce of castor oil in capsule had been given. Having great suspicion that the patient was still taking veronal by means of trickery, I again impressed the husband to redouble his efforts to find out whether this was so. This he did by the very ingenious method of telling the nurse that my orders were for the patient to be moved into an adjoining room on account of the light and ventilation, and whilst saying this he had full view of his wife by standing in front of a looking-glass and pretending to brush his hair. It was not long before he noticed the patient trying to get her hand beneath the mattress, and on going immediately to the bedside he discovered that his wife had another bottle of veronal tablets concealed there. On each of the subsequent visits the patient implored me to give her some more of the drug, even going so far as to threaten if I did not comply with her wish. With the aid of a strong purgative and regular nourishment recovery was very speedy; all the symptoms disappeared except those of the skin, which still remained in a rough condition. On the 29th she was able to leave London for the country. Before leaving she gave me the following information.

"A few days before I first saw her, December 13th, she had consulted a medical man on account of sleeplessness. He prescribed veronal in the form of the cachets, telling her to take one cachet containing eight grains just before retiring to bed. Instead of keeping to his directions, on the evening of December 10th she took two cachets (sixteen grains). Being dissatisfied with the result obtained she took twenty-four grains on each consecutive night. Immediately after this I saw her for the first time and found her suffering from the symptoms described in the beginning of this article. It was not until the 21st that she commenced taking the drug again, and during the time I was attending her until her secret was found out she took 128 grains. These were taken in the form of chocolates made up to contain eight grains of the drug in each sweet. I have inquired of several druggists who deal in this narcotic as to its composition, but have failed to find one who can answer my question. Since attending this case I have met with three instances in which this drug has been employed. Two were of suicidal mania, whilst the third was a case of threatening delirium tremens. In all three cases the results were most satisfactory in every respect" (*Lancet*, 1, 1904, p. 224).

Analysis.—*Veronal* is a colourless, crystalline solid, which melts at 182° C. Viewed under a low power ($^{2}/_{3}$), the crystals appear as hexagonal prisms, or in kindred forms. They dissolve with difficulty in water, floating obstinately at the top of the liquid in spite of shaking. The addition of a drop of caustic potash makes solution easy. In the solution so obtained, mercuric nitrate solution produces an abundant white precipitate. When a mixture of the dry substance with dry sodium carbonate is heated in a test tube, ammoniacal vapours are freely evolved which colour moist red litmus paper blue, and moist turmeric paper brown, when these test papers are held in the mouth of the tube (Hugh Candy).

Cases.—Since the last edition the editor's prophecy has unfortunately proved only too true, and cases have become very frequent. A case fatal after about 100 grains is reported in the *Lancet*, 1, 1909, p. 1496, with comments on p. 1557. Two at least have come under the editor's personal observation, and many others are reported.

The editor is indebted to Dr. Durrant for the following details of a fatal case of veronal poisoning, on which an inquest was held in July, 1909:

The victim was a man æt. 33. He had been drinking for years, often heavily; veronal had been previously prescribed for him in fifteen-grain doses, also chloral hydrate gr. x. and Am. Brom. gr. xx. He had gradually increased the dose of veronal and was taking indiscriminately thirty to sixty grains at times. Was worried by domestic trouble, and often threatened suicide. Had taken 100 grains of veronal with suicidal intent five weeks before his death and recovered in three days. On June 29th, 1909, obtained "two bottles" of veronal in five-grain tablets, retired to bed 12.30 to 1, and was seen by Dr. Durrant at 9.45 a.m., who then found one full bottle, twenty-five tablets, under his pillow, and one extra tablet, so that he had presumably taken 120 grains of veronal (also twenty grains of chloral and forty grains of Am. Brom.). He was then deeply comatose, surface warm, respirations 32, pulse 102 per minute, mucus in throat, cornea insensitive, pupils moderately dilated, reflexes abolished; at 12 noon was still comatose, pupils contracted, other conditions the same, but could be made to wince by slapping the face; at 8 p.m. the same, unable to swallow; 11 p.m. much the same, but pupils again dilated, and could swallow a teaspoonful at a time. At 9 a.m. on July 1st not quite so deeply comatose, pupils still dilated, could be made to wince by slapping the face, bowels not open, so ♏ j of croton oil administered; temperature 102·2°, pulse 110, reflexes still absent; at 10.30 p.m. temperature 102·4°, finger nails dusky, breathing impeded by mucus, bowels not open, so calomel gr. v. administered. On July 2 at 9 a.m. better; could be roused to speak a few words, pupils dilated, temperature 102·4°, pulse good, reflexes absent, bowels still not open, soon off to sleep again. Remained through the day in much the same condition, swallowed somewhat better, circulation better, and could be roused by speaking loudly. July 3rd, 9 a.m., condition much the same, temperature 102·8°, respiration 36, cough troublesome, bowels still not open, so ♏ j of croton oil repeated; cornea and pupils insensitive, not any more rousable, total muscular flaccidity and still no reflexes; at 2 p.m. not quite so well, respiration 36, pulse 120, temperature 102·8°; at 8 p.m. temperature 103·2°, pulse 130, respiration 40, more comatose. On July 4th at 2.30 p.m. temperature 104·2°, respiration over 40, pulse 150, died at 6.30 a.m., comatose.

Post-mortem examination: nothing found except intense congestion of lungs, liver, spleen, and brain, due, no doubt, to the asphyxial form of death. Mucous membrane of alimentary tract congested, otherwise normal.

Dr. Durrant draws attention to the obstinate constipation, to the absence of all reflexes, including the iris, to the pyrexia, and also to the improvement between the forty-eighth and seventy-second hours.

He also notices the ease with which drug-maniacs can get large quantities of their favourite drug, and the difficulties thrown in the way of those who would restrain such people from their habits.

Lastly, he remarks on the large number of cases of poisoning by veronal, several fatal, collected by the "Medical Annual" for 1907.

GROUP 6.—ARTIFICIAL ARTICLES NOT IN GROUP 5.

This group again is one purely of convenience in description, though in it several smaller groups occur, between the members of which there is real affinity and likeness. For interesting information as to the structure of these bodies and others in Group 5 the reader is referred to "Die Arzneimittel synthese auf Grundlage der Beziehungen zwischen Chesmichen Aufbau und Wirkung," by Dr. G. Frankel (Berlin, 1901, price 12*s.*); for criticism of same *vide Lancet,* 1, 1901, p. 333.

Sub-Group 1.—Hydrocyanic acid and the cyanides, a very natural group, acting by the formation of Cy-hæmoglobin.

Sub-Group 2.—Organic acids acting as irritants in large doses. Acetic, tartaric, tannic, and picric acids are noticed.

Sub-Group 3.—Substances containing a nitrite element, all acting as violent vaso-dilators, nitroglycerine is the typical member; amyl nitrite, cordite and roburite are also mentioned.

Sub-Group 4.—Substances, principally of coal tar origin, agreeing in that they have an antiseptic action (carbolic acid itself—*vide,* however, "Corrosives"—should be here). On this sub-group the following note from the *Lancet,* 1, 1897, is worthy of quotation:—

"Not a few cases have been recorded of late of death following upon the swallowing of tar acid mixtures described as non-poisonous. An important case was recently reported from Huddersfield, in which it appears a woman took a large quantity of a compound called 'germol,' which is supplied by a Huddersfield firm of manufacturing chemists. On this occasion the 'germol' was contained in a bottle marked 'Sanitas.' The evidence at the inquest led to the verdict that death was the result of asphyxia produced by corrosive poison contained in a disinfectant called crude 'germol.' 'Germol,' however, as we find from a small specimen submitted to us, is described on the label of the bottle as non-poisonous and for external use only. We have pointed out before that manufacturers are not justified in calling these fluids non-poisonous. It may be perfectly true that they have not the same powerful poisonous action as carbolic acid, but still they are poisonous, as in the above instance, in moderately large doses, and therefore it would be more correct to describe them as less poisonous than carbolic acid. There are a great number of similar preparations of this kind in the market at the present time, all of which the public are led to infer are quite non-poisonous. They consist of an alkaline mixture of the phenol derivatives of coal tar. It seems to us that if carbolic acid is to be scheduled as a poison these preparations, which are of a kindred character, should be included, for we have already received sufficient evidence to justify such a course."

The following are noticed :—

1. Creolin.
2. Lysol.
3. Creosote.
4. Coal Naphtha.
5. Benzene.
6. Naphthaline.
7. Naphthol Camphor.
8. Iodoform.
9. Resorcin.
10. Formaldehyde.

Sub-Group 5.—A number of substances the bond of connection between which is their close relationship to aniline.

1. Anilin.
2. Nitrobenzene.
3. Phenyl hydroxylamine.

Sub-Group 6.—Paraffin, Pyridine, Piperazine.

SUB-GROUP 1.—POISONING BY HYDROCYANIC ACID AND THE CYANIDES.

Source and Method of Occurrence.—The acid itself is a medicinal drug ; official dose of the dilute (2 p.c. by weight of HCN) acid, 2 to 6 minims; the cyanides are freely used in the arts, in extraction of gold from quartz, and in photography, etc.

Cyanide of Potassium is a compound of hydrocyanic (prussic) acid, containing 41 per cent. of the latter poison. The commercial cyanide is impure, containing also cyanate and carbonate of potassium. Cyanide of potassium is largely used in photography and in electro-gilding and silvering. Commercial cyanide of potassium has a local chemical action upon the skin; and if this is abraded or wounded, it may be absorbed and produce serious effects. Some accidents of this kind have occurred in the practice of photography (" Ann. d'Hyg.," 1863, 1, 454).

Cyanide of Silver.—One death occurred from the taking of this substance in 1880. Notwithstanding its great insolubility, it is readily decomposed by the free hydrochloric acid of the gastric juice, prussic acid being liberated.

Besides these ordinary chemical sources, the acid (or, rather, the base cyanogen in combination) exists in laurel-water, essence of peach and cherry kernels, and in the *essential oil of bitter almonds.* This liquid, which is used for the purpose of giving flavour and odour to confectionery, in its crude state owes its poisonous properties to the presence of prussic acid. It contains a variable quantity of the acid, sometimes 12 per cent. *Almond flavour*, or essence of peach kernels, contains one drachm of the essential oil to seven drachms of rectified spirit. Thirty-one deaths from this oil are reported to have occurred in England and Wales in four years. Poisoning by it is, however, now rare, as the crude poisonous oil is a scheduled poison, and can only be sold under restrictions. In 1891 there were fifteen deaths from cyanide of potassium in England and Wales. In 1901 there were four accidental deaths and no less than thirty-nine suicides from the acid and from cyanide of potassium.

Toxicity and Fatal Dose.—Hydrocyanic acid and the cyanides must certainly be reckoned amongst the most poisonous bodies. The toxicity of the acid would appear to be due to a combination of cyanogen with the hæmoglobin forming a condition not only useless to the tissues for respiratory purposes but also very actively poisonous (Kobert, "ueber cyanmethæmoglobin").

The *smallest* dose of this acid which is reported to have caused death was in a case which occurred to Hicks (*Med. Gaz.*, vol. 35, p. 896). A healthy adult woman died in twenty minutes from a dose equivalent to **nine-tenths of a grain of anhydrous prussic acid.** This was equivalent to *fifty-four minims* of the pharmacopœial acid. In one case (*Med. Gaz.*, vol. 36, p. 104), a stout healthy man swallowed this dose, *i.e.* nine-tenths of a grain, by mistake, and remained insensible for *four hours*, when he vomited and began to recover. The vomited matters had *no odour* of the poison, showing that, if not concealed by other odours, the whole of the acid must have been absorbed. He had a very narrow escape of his life. Banks published a case in which a female recovered after swallowing thirty drops of prussic acid (*Edin. Med. Surg. Jour.*, vol. 48, p. 44). The *largest* dose from which an adult has recovered was probably in a case which has been reported by Burman (*Lancet*, 1854, 1, p. 39), but in any records of cases, so far as regards dose, but little reliance can be placed upon them, for these reasons: (*a*) the acid is very volatile and (*b*) very easily decomposed by exposure to light for a length of time, and hence when a person takes a dose of the ordinary liquid preparations of the acid the strength is a very problematical factor.

From the facts hitherto observed, we shall not be far wrong in assuming that *about fifty minims* of pharmacopœial acid (two per cent. i.e. *one grain of anhydrous acid*), or an equivalent portion of another acid, would commonly suffice to destroy the life of an adult. This is the nearest approach that we can make to the *smallest fatal dose*. In *R.* v. *Bull* (Lewes Aut. Ass., 1860) a question arose respecting the minimum fatal dose of this poison.

The accused, a young medical man, was charged with the manslaughter of his mother, a woman æt. 66. He had prescribed for her prussic acid to relieve sickness. He procured a bottle of Scheele's acid, said to contain one drachm. He administered four minims to the deceased in the morning, and it appeared to benefit her. In the evening he gave to her another dose, amounting, according to his statement, to "seven drops." The deceased went upstairs, became insensible, and died in a few minutes. When the bottle was examined twenty-five minims remained in it; hence thirty-five minims were alleged to be missing, but the druggist who sold the acid poured out the quantity conjecturally, and the bottle was found to have a broken cork. The strength of the acid had not been determined. Under these circumstances the prisoner was acquitted.

In this case the Court desired to know the relation of drops to minims, but no satisfactory answer could be given. The size of a drop materially depends on the nature of the liquid, the mouth of the bottle, and the rapidity of the measurement. Seven drops of Scheele's acid dropped from a small phial measured seven minims. There can be no doubt in the above case that the poison caused death, and unless we assume that seven drops or minims will destroy life, which is not probable, the deceased must have taken a much larger dose than the accused had intended. Scheele's acid is twice the strength of the pharmacopœial acid: the latter contains two per cent. of prussic acid, and its official dose is two to six minims.

Of KCN five grains have caused death in a quarter of an hour, but recovery has followed the swallowing of forty grains. *Vide* also p. 314 with reference to habit.

Duration.—It is one of the most formidable poisons known to chemists. It has destroyed life in a quarter of an hour. A dose of five grains of KCN, equal to two grains of prussic acid, has proved fatal in three minutes. In one case the person died in two hours (*Chem. News*, September 5th, 1863). One of the strongest diagnostic points in poisoning by this acid or the cyanides is the rapidity with which the symptoms appear; they commonly appear more rapidly than with any other solid or liquid poison, and are only equalled in this respect by those of CO and a few other gaseous bodies. In some instances there may be loss of consciousness in a *few seconds;* in others, certain acts indicative of volition and locomotion may be performed, although requiring for their performance several *minutes.* When the dose is two drachms and upwards, we may probably take the average period for death at from **two to ten minutes**. In Hicks' case twenty grains of Scheele's acid destroyed life in twenty minutes. In this respect, death by prussic acid is like death by lightning; the person in general either dies speedily or recovers altogether. Death has occurred in the human subject as early as the *second*, and as late as the *one hundred and twentieth minute.*

In 1891, a medical man died in Guy's Hospital, having lived at least two hours after suicidally swallowing a fatal dose of the acid. This is, the editor believes, the longest fatal case of prussic acid poisoning on record.

But although death does not commonly ensue until after the lapse of a few minutes, sensibility, and consequently a power to perform certain acts of volition and locomotion, may cease in a few seconds. The time at which this loss of muscular power is supposed to take place has frequently become an important medico-legal question; and on the answer to it the hypothesis of suicide or murder in a particular case may rest. The reason for the differences is not clear, but the following case, *Lancet*, 1, 1903, with remarks, is a case in point:

As a final example of strange suicides whilst in bed we may refer to the case of a maid-servant who was found dead. The body lay at full length, with the head turned a little on one side, the arms crossed over the trunk, and the bed-clothes pulled up smoothly to the chin. Under the clothes, on her right side, lay a corked phial which was wrapped in paper and contained three and a half drachms of hydrocyanic acid. From the size of the bottle it was probable that four and a half drachms of the poison had been swallowed, and the question arose, could the girl after taking this quantity of the poison have corked the bottle, wrapped it up, and adjusted the clothes?

A man was suspected of having murdered her, but as several cases were quoted at the trial showing that in other instances of undoubted suicide similar acts had been performed the prisoner was acquitted. Such cases afford considerable difficulty to jurists and no general lines can be laid down for their elucidation; each case must be considered in detail as it occurs.

The following cases emphasise the fact that movement is possible:—

On November 4th I received an urgent message to see Miss A. A few minutes afterwards I found the patient, a girl, aged twenty, at the foot of the staircase, breathing stertorously, unconscious, convulsed, with widely-dilated pupils, no pulse at the wrist, and cold. Her mother informed me that Miss A. had gone upstairs to change her dress, intending at the same time to do some photographic work. She shortly afterwards heard her rush out of her room calling "Mother!" immediately afterwards falling downstairs, convulsed and very sick. There was a strong odour of bitter almonds in her breath and vomit, and I came to the conclusion she had in some way poisoned herself with cyanide of potassium or prussic acid. She was perfectly well half an hour before the occurrence.

I removed her to bed, and at once injected $\frac{1}{100}$ gr. of digitalin and $\frac{1}{50}$ gr. of strychnine, followed by two syringefuls of brandy, and also commenced artificial respiration and general friction. Shortly afterwards there was some feeble pulsation at the wrist, and with the aid of a battery (which had by that time been obtained), fresh injections of brandy, hot bottles, and mustard over the heart, the patient gradually rallied, not, however, before she had several alarming relapses. She was several times sick and slightly convulsed. The pupils were widely dilated the whole time. She did not recover consciousness until fully three hours after the accident, but then rapidly rallied, and in the evening only felt faint and sick.

On searching her bedroom a large piece of cyanide of potassium, and a penknife with which she had been scraping it to a powder, were found. How she managed to convey a portion of this powder to her mouth she is quite unable to say, as she remembers nothing of the whole occurrence, although there must have been a momentary period of consciousness after taking the poison, as she was able to rush out and cry for help (Leonard C. Dobson, *B. M. J.*, 1, 1896, p. 17).

A woman, who at the time was under medical treatment, took by mistake a teaspoonful of a solution of cyanide of potassium, containing about seven grains of the salt. Immediately after taking it she complained of a severe burning pain in the stomach, and feeling as if the bowels were about to act. She went to the water-closet, and her strength left her. She was removed to bed, and speedily became unconscious. It was found impossible to introduce anything into the stomach. She died in less than an hour. There was no convulsion before death, but a sudden convulsive action of the body took place after the heart had ceased to beat. The appearance of the body was so natural, even on the day following death, that some of her friends supposed that there might still be life (*Boston Med. and Surg. Jour.*, December 11th, 1856, and *Brit. and For. Med. Rev.*, 1857, vol. 19, p. 498). In 1856, a woman swallowed an ounce and a half of a solution of cyanide of potassium, used for photographic purposes. The quantity taken amounted to five grains. In two minutes she became unconscious, the whole of the body was slightly convulsed, and the pupils of the eyes were dilated. She foamed at the mouth, the pulse was small and feeble, and there was spasmodic closure of the jaws. Nevertheless, as she had lost some teeth, there was sufficient space for the introduction of the tube of the stomach-pump, within five minutes after she had taken the poison. She died in twenty minutes.

Symptoms.—When the patient has been seen within a minute or two he has been perfectly insensible, the eyes fixed and glistening, the pupils dilated and unaffected by light, the limbs flaccid, the skin cold and covered with a clammy perspiration; there is convulsive breathing at long intervals, and the patient appears dead in the intermediate period; the pulse is imperceptible, and involuntary evacuations are occasionally passed. The respiration is slow, deep, gasping, and sometimes heaving or sobbing. The following case presents a fair example of the immediate effects of this poison in a large and fatal dose:

A medical man swallowed seven fluid drachms of the common prussic acid. He survived about four or five minutes, but was quite insensible when discovered, *i.e.*, about two minutes after he had taken the poison. He was found lying on the floor senseless; there were no convulsions of the limbs or trunk, but a faint flickering motion was observed about the muscles of the lips. The breathing appeared to cease entirely for some seconds: it was then performed in convulsive fits, and the act of expiration was remarkably deep, and lasted for an unusual time.

When the dose is large, the breath commonly exhales a strong odour of the acid, and this is also perceptible in the room. Convulsions of the limbs and trunk, with spasmodic closure of the jaws, are usually met with among the symptoms; the finger-nails have been found of a livid colour, and the hands firmly clenched. The breathing is generally convulsive, but when the coma or insensibility is profound, it is sometimes stertorous. The breathing in prussic acid poisoning is of a special and peculiar character. The intervals between the respirations are prolonged, followed by tedious and spasmodic respirations, the inspirations being short, and the expirations very protracted.

A medical student took a drachm and a half of Scheele's prussic acid. He was heard to call out once or twice, and a gentleman sleeping in the next room ran to his assistance. He was heard to fall from the sofa to the floor, and when picked up was found to be already insensible. Hilton Fagge saw him a little later—fifteen to thirty minutes after the poison was taken. He was then lying on a sofa, quite insensible. The limbs were paralysed, and lay in any position in which they were placed; and they were free from all rigidity. The jaws were clenched. The pupils were normal. There were no convulsions, nor had there been any. The face was not livid. The pulse was very rapid, the respirations very infrequent. Cold water dashed on the face produced at each application deep respiratory efforts. An attempt to administer an emetic failed, in consequence of inability to swallow. Strong ammonia applied to the nostrils failed to produce the slightest stimulation. After a time the breathing became slower—seven in a minute; and it was distinctly stertorous. The pulse became slower, and markedly feebler; and now cold affusion failed to produce any effect. The respirations fell to four in a minute, the face became blue, and the pulse imperceptible at the wrist. Breathing ceased in from an hour to an hour and a half after the poison was swallowed. There was a marked odour of prussic acid in the room; but it was not noticed at first whether the breath smelt of the acid (Guy's Hosp. Rep., 1869, p. 259).

When a small dose (*i.e.* about thirty minims of a weak acid) has been taken, the individual has first experienced weight and pain in the head, with confusion of intellect, giddiness, nausea, a quick pulse, and loss of muscular power; these symptoms are, however, sometimes slow in appearing.

Vomiting has been occasionally observed, but it is more common to find foaming or frothing at the mouth, with suffusion or a bloated appearance of the face, and prominence of the eyes. If death results, this is preceded by tetanic spasms, opisthotonos, and involuntary evacuations. Vomiting is sometimes the precursor of recovery (see cases in *Med. Gaz.*, vol. 36, p. 103; vol. 35, pp. 859, 893). A case which occurred to Bishop (*Prov. Med. and Surg. Jour.*, August 13th, 1845, p. 517) was remarkable in several particulars: the man swallowed, it was supposed, forty minims of an acid (of three and a quarter per cent.), or one and a quarter grains of real prussic acid, and was able to give an account of his symptoms. He was conscious for some time after he had taken it, and he recollected experiencing the sensation of his jaws becoming gradually stiff and tight.

The potassium salt has a bitter taste, producing first a sense of coldness on the tongue followed by a feeling of constriction, and burning heat in the throat.

The symptoms which the cyanide produces are similar to those occasioned by prussic acid:—insensibility, spasmodic breathing, convulsions, and tetanic stiffness of the jaws and body. They appear in a few seconds or minutes, and run through their course with great rapidity. An acid state of the stomach, by liberating prussic acid from the salt, is thought to hasten its effects.

Treatment.—Immediate evacuation of the stomach with stomach-pump or emetics. Zinc sulphate or mustard may be given by the mouth, or apomorphine subcutaneously; then artificial respiration, faradisation of the phrenics and the diaphragm, external warmth and friction, subcutaneous injections of ether, brandy by the mouth or rectum, and if the surface is not cold, effusion with cold water. If effusion is resorted to it should be intermittent: either vigorous friction or hot applications being used in the intervals. Subcutaneous injections of atropine have been recommended on theoretical grounds—stimulation of the respiratory centre; the advantage is doubtful. Chemical antidotes are useless: first, because all the poison should be evacuated, and not left for chemical neutralisation; and second, because the action of the poison is far too rapid to permit of the effective administration of an antidote that requires special ingredients, and time to prepare it (Mann).

J. Kossa, considering that potassium permanganate ought, theoretically, to act as a chemical antidote to potassium cyanide, by checking the paralysis of the respiratory centres, has performed some experiments, the results of which appear to fully justify his hypothesis. Rabbits were shown to be fatally affected in a few minutes by 0·01 gm. of the poison, but if, at the time of administration, 0·5 gm. of permanganate dissolved in fifty cc. of water was also introduced into the stomach, doses of cyanide up to 0·1 gm. failed to cause death. Larger quantities (0·2 gm.) proved fatal under similar conditions, but the action of the poison was much delayed. Successful experiments were also performed with aqueous solutions of hydrocyanic acid containing 0·1 per cent. It is suggested, therefore, that, in cases of cyanide poisoning, one-half to one-third litre of a 3 to 5 per cent. solution of permanganate be administered immediately (*Vratch*, through *Nouv. Rem.*, ix., 567). Antal (*Physiol. Studien aus d. Univ. Budapest,* 1895) observes that although the cyanides are the strongest of poisons, yet the rapid form of death only occurs in a small proportion of cases of poisoning by them. Atropine recommended by Preyer against the remote effects has given negative results. Potassic permanganate used by Kossa is perhaps the most efficient of chemical antidotes, yet it also is useless when the poison has got into the circulation. Antal has investigated the action of cobaltum nitricum oxydulatum in this respect. When cyanides are present in the stomach of an animal, and a solution of this cobalt salt is introduced, a harmless potassic cobalticyanide (K_3CoCy_6) is formed. That the cobalt salt can render absorbed cyanides harmless is due to the rapidity of its absorption and to the small quantity needed to make large quantities of cyanide inert.

Antal records a series of experiments to show the antidotal properties of the above-named cobalt salt. When rabbits or dogs are given a lethal dose of cyanide, and a half to one per cent. of the cobalt salt is introduced into the stomach, no poisonous effects are produced. Experiments are also related which show that this solution, subcutaneously injected, will also neutralise the effects of absorbed cyanide.

He concludes that in man, to render inert already absorbed cyanide, one half per cent. solution of the above-named salt (ten to thirty c.cm.) should be injected subcutaneously; at the same time the same solution should be given by the mouth or, if that is impossible, passed into the stomach by means of a tube to neutralise any cyanide still present there (*B. M. J.*, Epit., 1895, 1, p. 44).

Post-mortem Appearances.—The body when seen soon after death often exhales the odour of prussic acid; but if it has remained exposed before it is seen, and if it has been exposed to the open air or in a shower of rain, the odour may not be perceptible; again, the odour may be concealed by tobacco-smoke, peppermint, or other powerful odours. In a case in which a person poisoned himself with two ounces of the acid, and his body was examined twenty-eight hours after death, the vapour of prussic acid, which escaped on opening the stomach, was so powerful that the inspectors were seized with dizziness. In cases of suicide or accident, the vessel out of which the poison has been taken will commonly be found near; but there is nothing to preclude the possibility of a person throwing it from him, or even concealing it if the symptoms should be delayed (see Christison, p. 379). Owing to the great volatility of the poison, the vessel, if left uncorked, may not retain the odour when found. Putrefaction is said to be accelerated in these cases; but there seems to be no ground for this opinion (case in *Prov. Med. Jour.*, July 30th, 1845).

Externally, the skin is commonly livid, or violet colour; the nails are blue, the fingers clenched, and the toes contracted; the jaws firmly closed; foam or froth forms about the mouth, the face is often pallid, but sometimes bloated and swollen, and the eyes have been observed to be wide open, fixed, glassy, very prominent and glistening, and the pupils dilated; but a similar condition of the eyes has been observed in other kinds of violent death. *Internally*, the venous system is gorged with dark-coloured liquid blood; the stomach and intestines may be in their natural state; but in several instances they have been found more or less congested. The mucous membrane of the stomach is often reddened throughout, and may present the appearance met with in cases of arsenical poisoning. In a large number of experiments upon dogs, Nunneley found generally a congested condition of the mucous membrane of the stomach: if empty at the time the poison was taken, the organ was found much contracted, and of a brick-red colour. This appearance of congestion was observed on the mucous membrane of the vagina, the rectum, and conjunctiva, when the acid was applied to these parts ("Prov. Trans.," N.S., vol. 3, p. 79). Redness of the stomach is common. In the following case this redness of the mucous membrane was well marked:—

A healthy man, æt. 30, swallowed a large dose of prussic acid. He was soon afterwards found dead in his bed. The body was inspected in five hours: rigidity had then commenced, and there was some warmth. The face was pale, the eyes were half closed, not presenting any remarkable brilliancy nor prominence, and there was great dilatation of the pupils. The mouth was closed, and no froth issued from it. The abdomen was the only cavity examined. The muscles were red, and gave out on section a good deal of fluid blood, which had a strong odour of prussic acid; the odour of the poison was also perceptible in the abdomen.

About eight ounces of a thick farinaceous mass were found in the stomach: the odour of prussic acid was very perceptible in this organ, but it was mixed with that of rancid food. The mucous membrane had everywhere, except at the greater end and posterior wall, a vivid inflammatory redness of a well-marked character, and it was covered with a layer of viscid mucus to a considerable extent. This membrane, even after it had been washed three times in water, gave out a strong odour of prussic acid.

In a case in which death had been caused by a large dose of the acid, there was a generally congested state of the mucous membrane of the stomach. A medical student destroyed himself by swallowing about one drachm of Scheele's acid. He was found in a state of collapse and breathing heavily, in about half a minute from the time at which he was last seen. He died in twenty minutes. The coats of the stomach were greatly congested towards the cardiac end. The minute vessels throughout were filled with dark blood, and there were some spots of effused blood beneath the mucous coat. The intestines were highly congested, the small vessels being visible all over the coats. There was no congestion of the membranes of the brain. Frank has recorded the appearances in two cases which fell under his notice (Horn's *Vierteljahrsschr.*, 1868, 2, 179).

In Bull's case (*infra*), on inspection nine hours after death no odour of the oil was perceptible in the chest, head, nor heart, nor in the venous blood with which the system was gorged. The lungs and heart were healthy. The vessels of the brain were congested, and there was a general effusion of serum on the hemispheres. The lining membrane of the stomach was much congested. On opening it the bitter-almond odour was quite perceptible (*Prov. Med. Jour.*, September 11th, 1844, p. 364). In the case of a boy (*supra*), which proved fatal in a quarter of an hour, on inspection there was pallor of the face, with lividity of the depending parts; the lungs were congested; the odour of the poison was perceptible only in the abdomen, and very distinctly in the contents of the stomach. The mucous coat of this organ was generally pale, but there were some patches of ecchymosis scattered over it. The essential oil and prussic acid were detected in it (*Lancet*, July 12th, 1845, p. 40). In a case which proved fatal in three hours, the skin was partially livid, the blood fluid, and the membranes of the brain as well as the lungs were gorged. The contents of the stomach had a strong smell of the oil, and the mucous coat towards the intestinal opening had a red appearance. The other organs were healthy. The blood with which the venous system is gorged, is generally liquid and of a dark colour.

Analysis.—Prussic acid is limpid like water; it possesses a slight acid reaction, and its vapour has a peculiar odour, which when the acid is concentrated, although not at first perceptible, is sufficient to produce giddiness, insensibility, and other alarming symptoms. The tests which are best adapted for the detection of this poison, either in liquid or vapour, are equally applicable, whether the acid is concentrated or diluted, and so far as the detection of the *vapour* is concerned, whether the acid is pure or mixed with other liquids or solids. *In the simple state,* the tests are: the *Silver*, the *Iron*, and the *Sulphur* tests.

1. *The Silver Test. Nitrate of Silver.*—This yields, with prussic acid, a dense white precipitate, speedily subsiding in heavy clots to the bottom of the vessel, and leaving the liquid almost clear. The

precipitate is identified as cyanide of silver by the following properties:—*a.* It is insoluble in cold nitric acid; but when drained of water, and a sufficient quantity of strong acid is added, it is easily dissolved on boiling. *b.* It evolves prussic acid, when digested in hydrochloric acid. *c.* The precipitate, when *well dried,* and heated in a small reduction-tube, yields cyanogen, which may be burnt as it issues, producing a rose-red flame with a blue halo. This is a well-marked character, and at once identifies the acid which yielded the precipitate as prussic acid. By this property, the cyanide is eminently distinguished from all the other salts of silver. In the employment of the silver test for the detection of the *vapour* of the poison, we place a drop of the silver solution in a watch-glass, and invert it over another watch-glass or beaker containing the suspected poisonous liquid. Cyanide of silver, indicated by the formation of an opaque white film in the solution, is immediately produced, if only in a moderate state of concentration. One drop of a diluted acid containing less than 1-50th of a grain of the anhydrous acid produces speedily a visible effect. When the prussic acid is more diluted, a few minutes are required; and the opaque film begins to show itself at the edges of the silver solution. In this case the action may be accelerated by the heat of the hand. If the vapour is allowed to reach the nitrate of silver gradually and much diluted with air, then, instead of an opaque film of cyanide of silver, crystals well defined under the microscope will be slowly produced, and these will constitute an additional proof of the presence of the acid in a state of vapour. These crystals have the form of slender prisms with oblique terminations. They are often grouped, and generally require a high magnifying power to render them visible.

2. *The Iron Test.*—The object of the application of this test, is the production of *Prussian blue.* We add to a small quantity of the suspected poisonous liquid, a few drops of a solution of potash and of green ferrous sulphate. A dirty green or brownish precipitate falls; on warming this, and then adding dilute hydrochloric or sulphuric acid, the liquid becomes blue; and Prussian blue of its well-known colour, unaffected by diluted acids, subsides. If the prussic acid is in small quantity, the liquid is at first yellow, from the ferric salt formed; it then becomes green, but the precipitate ultimately subsides so as to appear of a deep blue colour in mass. The iron test may be employed for the detection of the *vapour* of prussic acid, by the same method as that described in speaking of the silver test. For this purpose we place a few drops of a solution of potash in a watch-glass or saucer, and invert it over the suspected liquid. After a few minutes' exposure a drop of solution of green ferrous sulphate may be added, and then a drop of diluted hydrochloric acid, when Prussian blue will appear. The silver and the iron tests may be easily conjoined in testing the same quantity of poison. If the precipitated cyanide of silver, obtained by the addition of nitrate of silver to the suspected liquid, is dried and then moistened with strong hydrochloric acid, the vapour may be collected in a watch-glass or saucer, on the plan above described. Prussian blue will be procured, and thus corroborate the action of the silver test.

3. *The Sulphur Test.*—If a small quantity of yellow sulphide of

ammonium is added to a few drops of a solution of prussic acid, and the mixture is gently warmed, it becomes colourless, and, on evaporation, leaves crystals of sulphocyanide of ammonium—the sulphocyanic acid being indicated by the intense blood-red colour produced on adding to the dry residue a solution of a nearly neutral ferric salt: this red colour immediately disappears on adding a few drops of a solution of corrosive sublimate. The colour is also destroyed by strong acids, and its intensity is diminished by moderate dilution with water. This process is very delicate, and it therefore requires some care in its application: thus, if the boiling and evaporation are not carried far enough, the ferric salt will be precipitated black by the undecomposed sulphide; and, if the heat be carried too far, the sulphocyanide of ammonium may itself undergo decomposition, and be lost. The evaporation should therefore take place over a water bath. It will be perceived, too, that it requires a longer time for its application than either the silver or the iron test. If the prussic acid contains traces of Prussian blue or a salt of iron, it will acquire a dark colour on the addition of the sulphide.

The great utility of the *sulphur test*, however, is in its application to the detection of the minutest portion of prussic acid when in a state of *vapour*. In this respect it surpasses any other process yet discovered. In order to apply it, we place the diluted prussic acid in a watch-glass, and invert over it another watch-glass, holding in its centre one drop of the yellow sulphide of ammonium. No change apparently takes place in the sulphide; but if the watch-glass is removed after the lapse of from half a minute to ten minutes, according to the quantity and strength of the prussic acid present, crystallised sulphocyanide of ammonium will be obtained on gently evaporating the liquid to dryness. With an acid of from 3 to 5 per cent. the action is completed in ten seconds. The addition of one drop of the neutral ferric sulphate (free from nitric acid) to the dried residue, brings out the blood-red colour instantly, which is intense in proportion to the quantity of sulphocyanide present. When the prussic acid is much diluted, the warmth of the hand may serve to expedite the evolution of the vapour.

Prussic Acid in Organic Liquids. Detection without Distillation.—The organic liquid may be placed in a wide-mouthed bottle, to which a watch-glass has been previously fitted as a cover. The capacity of the bottle may be such as to allow the surface of the liquid to be within one or two inches of the concave surface of the watch-glass. The solution of *nitrate of silver* is then used as a trial test in the way already described. If the 1-200th of a grain of prussic acid is present, and not too largely diluted, it will be detected (at a temperature of 60° F.) by the drop of nitrate of silver being converted into an opaque white or crystalline film of cyanide of silver, the chemical change commencing at the margin. We may then substitute yellow sulphide of ammonium for the nitrate of silver, and proceed in the manner above described. It may be sometimes necessary to place the bottle in a basin of warm water. If the solution of silver is tarnished by sulphuretted hydrogen, as a result of putrefaction, the sulphur test alone should be used. By this process prussic acid was detected in the stomach of a person poisoned by it, as late as twelve days after death. After the stomach had been exposed for a few days longer, all traces of the poison had disappeared.

Detection by Distillation.—The organic liquid should be faintly acidulated with tartaric acid distilled in a water-bath at 212° F., and about one-sixth or one-eighth of the contents of the retort collected in a receiver kept cool by water. The tests may now be applied to the distilled liquid. If the trial test indicate that the quantity of poison is small, a solution of nitrate of silver or of caustic potash may be placed in the receiver, to fix the acid as it is distilled over; Prussian blue may then be procured in the manner described, or the vapour may be at once absorbed by yellow sulphide of ammonium in the receiver, and the liquid evaporated to obtain sulphocyanide. Prussic acid has been found in the stomach by *distillation* so late as *seven* days after death, although the odour could not be perceived before distillation. In the case of Montgomery (Rep. of trial of Thompson, Glasgow Cir. Court, 1857, by Hugh Cowan, pp. 9 and 53), the deceased died in about fifty minutes after having taken two drachms of prussic acid (equivalent to three and a quarter grains of anhydrous acid). The death took place on September 13th; the body was buried on the 17th, and exhumed on the 30th. The parts removed were then put into stoppered bottles, and on October 5th the Drs. McKinlay detected prussic acid doubtfully by the odour, but distinctly by the three tests, in the stomach, before distillation, as well as in the liquid distilled from the stomach and its contents. They did not succeed in detecting its presence in the tissues. About five weeks subsequently to this analysis, the viscera, which had been kept closely secured in glass bottles, were examined by Maclagan. The heart, kidneys, and intestines gave no indication of the presence of the poison; but it was detected by the sulphur test, in the form of vapour, in one half of the spleen, although there was no odour of the poison. When the viscera containing the poison have undergone putrefaction, no trace of the acid may be found either by its vapour or by distillation. In this case it may have been converted into sulphocyanide of ammonium by sulphide of ammonium produced during putrefaction. The sulphocyanide may then be dissolved out of the dried viscera or liquids by alcohol, and the solution evaporated to dryness, the residue redissolved in water and tested by a ferric salt. In this way Sir Thos. Stevenson has detected the poison in blood kept for a year after death from prussic acid. Much is lost by reason of the great volatility of the acid. The author has found the vapour to traverse paper and wet and dry bladder in a few minutes. Hence all viscera suspected to contain prussic acid should be preserved in well-stoppered glass bottles.

In the Tissues.—Soon after death the poison may be easily detected in the blood, secretions, or any of the soft organs, by placing them in a bottle, and collecting the vapour in the manner already described. This will be found to be far more convenient and satisfactory than the process by distillation. After putrefaction the acid may be detected as sulphocyanide.

Oil of Bitter Almonds.—The *essential oil*, which is often called peach-nut oil, is colourless when pure, but it commonly has a pale yellow colour, and a strong odour of bitter almonds, by which it may be identified. It has a hot, burning taste, and a feeble acid reaction. It produces, when dropped on paper, a greasy stain which does not entirely disappear by the application of heat. It has a specific gravity of 1·043, and sinks in water, which dissolves about one-thirtieth part. It is soluble in alcohol and ether in all proportions. When mixed with a few drops of strong sulphuric acid, it forms a rich crimson-red liquid which, if exposed to air becomes yellow. When poured into cold water, the crimson colour is immediately destroyed, and a yellow colouring matter falls in globules. The smell and taste of this oil, with the chemical tests, are sufficient for its identification; but nitro-benzene possesses a similar odour, and has been mistaken for it. When pure, and free from prussic acid, it is rapidly converted by oxidation into crystallised benzoic acid. The impure oil undergoes this change slowly.

The vapour of prussic acid does not so readily escape from this oil as from the watery solution; hence the vapour tests do not so quickly give characteristic results. *Tests.*—1. Add to one or two drops of the oil a like quantity of yellow sulphide of ammonium. Mere mixture at a low temperature only produces sulphocyanate after standing ten minutes or longer; but if the liquid is warmed with alcohol the conversion is immediate, and the change is indicated by the blood-red colour struck on adding ferric sulphate to the liquid. If any unchanged sulphide should give a black colour, this may be removed by the addition of one or two drops of hydrochloric acid. 2. Dissolve one or two drops of the oil in alcohol and add to the mixture a few drops of a solution of potash, followed by a solution of ferrous sulphate, and then hydrochloric acid. Prussian blue is formed on warming the mixture and adding dilute sulphuric or hydrochloric acid. The silver test is inapplicable to the oil in its ordinary state. The vapour of the oil produces no change in a drop of a solution of nitrate of silver, except after long exposure. If, however, the oil be heated, there is an immediate production of the cyanide of silver. The two tests above mentioned, combined with the odour, are sufficient for all practical purposes.

Cyanide of Potassium.—Commercial cyanide of potassium is usually seen in hard white masses. It is deliquescent, and very soluble in water: the solution, when pure, is colourless, and has a strong alkaline reaction, a soapy feel, and a powerful odour of prussic acid. It is not very soluble in pure and strong alcohol. 1. It is decomposed by all acids, and prussic acid is set free. 2. The potassium is precipitated by tartaric acid and by platinic chloride. 3. It gives a white precipitate with nitrate of silver, which, when dried and heated, possesses all the properties of cyanide of silver. This precipitate is easily redissolved by a slight excess of the solution of cyanide of potassium. 4. If a solution of ferrous sulphate is added to a solution of the cyanide of potassium, and after agitation, dilute sulphuric acid, Prussian blue will result. 5. A single grain of this salt moistened with water in a watch-glass, gives a well-marked reaction, by its vapour, with the silver and sulphur tests. Should this experiment fail, a drop of yellow sulphide of ammonium may be heated with the cyanide—the liquid acidulated with hydrochloric acid, and a solution of ferric sulphate added. The red colour of ferric sulphocyanate immediately appears.

Potassium Cyanide in Organic Substances.—The salt may be obtained as a soluble fixed residue from organic matter by drying and incinerating it in close vessels; or prussic acid may be at once procured by distilling the contents of the stomach with diluted sulphuric acid.

Lwow has detected cyanide of potassium in the body one hundred days after death ("Ann. d'Hyg.," 1882, t. viii., p. 571), and Zillner four months after death (*Vierteljahrsschrift f. Gerichtl. Med.*, xxxv., 1882, p. 193).

Cases.—The following possess some features of interest.

In 1899 at Pershore, Worcestershire, Dr. Emerson met with a case in which, although the victim (suicide) had swallowed a large dose, there was no smell of the acid in the room or at the lips of the body, although less than one and a half hours had elapsed when he was found; he was found lying in his armchair as though he had died from heart failure of natural origin. There was no smell on removing the stomach, and only a faint odour from the lungs. On opening the jar in which the stomach had been preserved there was, however, a strong smell of the acid.

In 1904 the notorious Whitaker Wright poisoned himself with cyanide of potassium after being sentenced to a term of penal servitude; and in his case every viscus smelt strongly of the acid, although he died within a minute or two after taking the dose.

In the *Chemist and Druggist* for May 15th, 1897, p. 773, is an interesting account of the destruction of an elephant by poison, but it is doubtful whether death was due to prussic acid or to aconite. The weight of the beast was 3 tons 12 cwt. At 12.15 he was given sixty grains of Merck's aconitine concealed in a carrot; this having no immediate effect he was, a quarter of an hour later, given four ounces of Scheele's hydrocyanic acid, and at intervals, three further similar doses; he died at 2.30. That the acid was potent was proved by the narrow escape of a boy who inhaled accidentally some of the fumes in filling the syringe, and was made very ill thereby, as also by the fact that a black bear, weight not stated, was killed by two ounces of the same. It seemed probable to the slayer that it was the aconitine and not the prussic acid that killed the elephant.

An extraordinary case of poisoning by the fumes of the acid is recorded (*Lancet*, 1, 1899, p. 43). Owing to an accident some gallons of strong sulphuric acid came in contact with a large quantity of cyanide of potassium in a small room in which were some children.

The following case of recovery after swallowing at least twenty grains of potassium cyanide is reported by T. R. Wigglesworth (*B. M. J.*, 1, 1897, p. 1039). A miner was seen to drink something from a bottle, throw the bottle away, and fall down in convulsions, foaming at the mouth.

> I saw him not less than fifteen minutes after drinking the fluid. He was lying insensible on his back on the floor (where he had been placed). His face was greyish-blue in colour, the mouth covered with foam, and the jaws tightly clenched, so much so that I broke one of his teeth in forcing open his mouth to insert the stomach tube. The eyes were intensely injected and fixed, and the pupils largely dilated, but the conjunctival reflexes were not entirely absent. The breathing was pectoral, the inspirations were jerky and sounded similar to a faint hiccough. The pulse was small and rapid. The arms were slightly flexed at the elbow, the fingers tightly contracted, and the thumbs pressed firmly into the palms; the abdominal muscles were rigid. There was no escape of urine nor of fæces.
>
> I examined the bottle, which contained a very small quantity of fluid, smelling strongly of potassium cyanide.
>
> As soon as I was able to separate his teeth sufficiently, I introduced the stomach tube, and washed out his stomach with clean water, and then injected a mixture of sulphate of iron, carbonate of potash, and pure ether, which was retained for about

five minutes, when he vomited, the vomit being distinctly stained blue. I then poured a stream of cold water over the back of the neck and spine, and over the region of the heart. His pulse and breathing rapidly improved, but the muscular contractions remained until 6.30 p.m., nor did he regain full consciousness until 8.15 p.m., when he spoke and answered questions quite rationally, although he denied all recollection of taking the poison, and as to where he obtained it. (I have every reason, however, to believe that he was not speaking the truth.) I then left him, giving him a mixture of sulphate of iron and carbonate of ammonium to take every hour. He complained next day of his teeth feeling tender, but was otherwise well.

Two cases of recovery from large doses of potassium cyanide are reported by W. F. Stevenson (*Lancet*, 1871, 1, p. 806). In 1862 a man swallowed the greater part of a solution containing an ounce of the commercial cyanide, which he had dissolved for the purpose. Taafe found the man a few minutes afterwards lying in the street insensible, and breathing stertorously; and in about ten minutes he applied the stomach-pump, and cold affusion freely. In two hours the man vomited, and from that time rapidly recovered.

In 1876, a patient was admitted into Guy's Hospital suffering from the effects of a handful of bitter almonds, which he had eaten. The symptoms were those of prussic acid poisoning, from which he recovered.

Mr. McCarthy related to the editor a curious case that occurred some years ago, in which a gentleman was fatally poisoned in Ireland by drinking the first glassful out of a new bottle of noyeau liqueur. There had accumulated in the bottle and floated to the top a sufficient quantity of prussic acid to kill.

In one case, a woman swallowed about seventeen drops of the essential oil of bitter almonds, and she died in half an hour. She was seen by Bull in about fifteen minutes: her face was livid, the lips separated, the teeth clenched, froth about the mouth, the eyes half shut and glassy, the pupils dilated and fixed, and there were heavings of the chest at intervals; there was no pulse, and the action of the heart was scarcely perceptible. No odour was perceived about the body until after the stomach-pump had been used. The first symptoms observed in this case were strong convulsions, the deceased throwing her arms about as if in pain. A boy, æt. 13, swallowed a quantity of the oil; he was found lying on the floor motionless and insensible; the face pale, the eyes opened and fixed, the pupils dilated, and he was rolling about and panting for breath; the pulse at the wrist was imperceptible; he died in a quarter of an hour without any convulsions appearing. A man, æt. 20, swallowed about two ounces of the oil. A person present saw him fall suddenly while in the act of swallowing: he made a loud cry, gave one deep expiration, and died.

In another case, a woman, æt. 46, who had been in the habit of using the almond essence for flavouring confectionery, swallowed about half an ounce (equal to thirty drops of the oil). She died in less than half an hour. When seen by a medical man ten minutes after she had taken the poison, she was perfectly insensible. The face was pale but swollen, and covered with perspiration; the eyes stared fixedly as if in terror; the pupils were dilated. The lips were partly closed and livid, and a frothy mucus issued from the mouth. The lower jaw was firmly contracted, while the muscles of the neck and of the limbs, excepting those of the fingers, were flaccid. She breathed slowly and heavily, making about ten respirations in a minute; the pulse was from 30 to 40, and feeble. There was an odour of bitter almonds in the breath. Some blood which was drawn from the arm was thick and dark, resembling choleraic blood. In spite of the use of the stomach-pump and cold affusion, the patient did not show any signs of recovery, but gradually sank (*Assoc. Med. Jour.*, December 13th, 1856, p. 1055). In 1853, a woman, æt. 39, swallowed half an ounce of *almond flavour*, containing half a drachm of the essential oil. In ten minutes she was perfectly insensible and motionless; the pupils were moderately dilated and insensible to light; the mouth was partly open, the lips were pale; there was no distortion nor spasmodic movement of the features; the pulse was slightly tremulous, and entirely ceased in a few minutes; the breathing was slightly stertorous, and took place at long intervals. She continued in this state for twenty minutes without any convulsive movements of the body, when she died, *i.e.*, half an hour after she had taken the poison. In another case two drachms destroyed life in seventeen minutes (*Lancet*, 1863, 2, p. 447).

POISONING BY AMMONIUM SULPHOCYANIDE AND POTASSIUM SULPHOCYANIDE.

Blyth ("Poisons") says that in large doses these salts are poisonous; the latter is a normal constituent of saliva in minute quantities, but in large doses is said to produce paralysis and convulsions, later probably asphyxial; these results have been obtained in rabbits and dogs. Christison termed it a feeble poison.

The editor finds a single case recorded in a human being:—

On Wednesday, February 28th, the borough coroner (Mr. H. Saunders French) held an inquest at the Hoop Hotel, Bridge Street, Cambridge, on the body of Florence Eliza Stearn, aged thirty-five, who had died after taking sulphocyanide of ammonium. Mr. David John Rygate, surgeon, deposed to being called in to see the deceased at 9.30 p.m. on Sunday, February 25th, when he was informed that, about 2 p.m., she had taken sulphocyanide of ammonium. The father of the deceased then told witness the story of the events of the day. Witness ordered the deceased to bed, and at 2.30 a.m. on Monday he found her unconscious, with rigidity of the muscles of the arms and jaws. By injections of ether attempts were made to revive her, but convulsions ensued and the deceased expired on Monday evening at 6.30. A post-mortem of the body had been made. He was of opinion that the deceased died from convulsions, whether caused by taking poison or not he was not absolutely certain, as he was not sufficiently competent to detect the small amount of poison which had been taken. The remedies applied got rid of the greater part of the compound, and he had not much doubt that the deceased died of the after-effects of the small quantity which got into the system. The jury returned a verdict of "Death from convulsions, probably caused by taking a quantity of sulphocyanide of ammonium whilst of unsound mind" (*Cambridge Chronicle*, reproduced in *Pharm. Jour.*, p. 791, for March 17th, 1894).

SUB-GROUP 2.—(1) POISONING BY ACETIC ACID.

Toxicity.—This acid has been generally excluded from the class of poisons, but in 1901 one fatal accident and one suicide were due to it. The editor is unable to find records of the cases. Common *vinegar*, which contains only 4 or 5 per cent. of acetic acid, has been often taken in large doses without injurious consequences. From the experiments performed by Orfila on dogs, and from one case which he reports as having occurred in the human subject, acetic acid, when concentrated, appears to exert an irritant action on the body (" Ann. d'Hyg.," 1831, 2, 159; also "Toxicol.," vol. 2, p. 198). This is not more than we might have expected, seeing that the concentrated acid is highly corrosive. In the case referred to, the deceased, a female, aged nineteen, was found dying on the highway. She suffered from convulsions, complained of pain in the stomach, and died in a short time. On inspection, the stomach was found neither softened nor corroded, but its mucous membrane near the pylorus was almost black. The mucous glands were prominent, and the vessels were filled with dark coagulated blood.

Pelletan observed in the case of a child, that the abuse of vinegar led to thinning of the mucous membrane of the stomach; and Landerer remarked that the milk of a wet nurse who had been in the habit of taking large quantities of the vinegar of roses, became thin, very acid, and deficient in casein and fat. The infant which she was suckling gradually wasted and died, and the woman herself suffered severely (Heller's "Archiv.," 1847, 2 H. S. 185).

Analysis.—*Vinegar*, which may be regarded as an organic mixture containing a small proportion of acetic acid, may be examined by distilling a portion, and testing the distilled liquid for the acid. Vinegar, as it exists in commerce, may contain a small quantity of sulphuric acid, and occasionally traces of lead and copper. In general it is easily recognised by its odour.

Case.—In the following case it is to be presumed that the acetic acid was mainly responsible, as red oxide of mercury is not a very active poison, at any rate as a corrosive.

C. S., a well-nourished girl, aged seventeen, was admitted to the Hereford Infirmary at midday on November 22nd, having swallowed half an hour previously one ounce of acetic acid, to which she had added an unknown amount of the red oxide of mercury. Evidence showed that the bottle she brought to the chemist's for the acid was perfectly clean. Afterwards there was found on the bottom of the broken bottle a red deposit, which on analysis proved to be red oxide of mercury. The inference drawn was that in addition to the ounce of acetic acid, thirty grains at least of the oxide had been taken, as it was proved that one drachm of acetic acid dissolved five grains of the oxide.

The symptoms were stertorous breathing, vomiting of frothy fluid, no blood; pain in throat and stomach, and frequent bloody evacuations from the bowel, many times copious clots being passed. The patient was conscious all through, but very collapsed; there were no convulsions, and very slight charring of the mouth. Treatment consisted of magnesia suspended in emulsion, lime water, and olive oil, with hypodermic injections of ether. The patient died, apparently from hæmorrhage, at 4.30 p.m. next day, seventeen hours after taking the poison.

On post-mortem examination eight hours after death, the œsophagus was inflamed and congested, and the stomach intensely so. At the pyloric end was a large patch, quite black and charred, with the mucous membrane quite destroyed; the organ was empty. The duodenum was also inflamed in patches, but not ulcerated. Both ventricles of the heart were contracted and empty. The trachea and larynx were inflamed as far down as the bifurcation of the bronchi. There was no peritonitis (*B. M. J.*, 1, 1896, p. 19).

Since the last edition several fatal cases have occurred through the incautious use of the acid for domestic purposes. *Vide Lancet*, 1, 1909, p. 656 ("What's in a name?"). *Vide* also *Lancet*, vol. 2, 1905, for additional cases, fatal.

(2) Poisoning by Tartaric Acid.

Symptoms and Appearances.—Tartaric acid is not commonly regarded as a poison; but at least one case has occurred, in which there was no doubt that it acted as an irritant and destroyed life. The case referred to was the subject of a trial for manslaughter (*R.* v. *Watkins*, C. C. C., January, 1845). The accused gave the deceased, a man, aged twenty-four, *one ounce* of tartaric acid instead of aperient salt. The deceased swallowed the whole, dissolved in half a pint of warm water; he immediately exclaimed that he was poisoned; he complained of having a burning sensation in his throat and stomach, as though he had drunk oil of vitriol, and stated that he could compare it to nothing but being all on fire. Soda and magnesia were administered with diluent drinks. Vomiting set in, and continued until death, which took place nine days afterwards. On inspection, nearly the whole of the alimentary canal was found highly inflamed. The accused admitted that he had made a mistake, and tartaric acid was found in the dregs of the cup. The jury acquitted the prisoner. Another case of poisoning by this acid, with a report of the results of analysis, has been published by Devergie (" Ann. d'Hyg.," 1851, 2, 422). This case gave rise to a controversy between Orfila and Devergie, the points in dispute relating chiefly to the processes for the detection of the acid in the stomach and tissues (" Ann. d'Hyg.," 1852, 1, 199, 382; and 2, 230).

Case.—In the *B. M. J.* for June, 1893, p. 1321, the following fatal case is reported by Dr. Edgar Trevithick, of Cheltenham:—

In this case death occurred on May 26th (this being the seventh day after ignorant self-administration), in a woman, aged 67. The exact amount taken I have unfortunately been unable to determine exactly. The woman herself owned to having taken " about two teaspoonfuls." That, I found, would represent between 140 and 180 grains. Since, however, both she and her husband at the onset of the symptoms, and for three days afterwards, refused to admit that she had taken anything likely to disagree with her, and seeing that it was with evident reluctance that on the fourth day the confession was obtained, it is not, I think, improbable that a larger dose than that mentioned above may in reality have been taken. With regard to the strength of the solution used, the probability is that it was of very considerable strength, since the draught was prepared in a small tumbler. The remnant of tartaric acid taken from the room was on examination found to be free from admixture or impurities. No other irritant poison was discoverable in the house, nor did any of the circumstances in any way point to the likelihood of any drug other than tartaric acid being concerned.

The symptoms at the outset were acute abdominal pains, vomiting and diarrhœa coming on in the above order. Pain and vomiting appear to have supervened almost immediately after the administration, and diarrhœa set in some few hours later.

When I first saw the patient, about twenty-four hours after the onset of the symptoms, I found her suffering from intense abdominal pain, and screaming out whenever she moved in bed. At this time the pulse was very fairly good, the tongue was already very dry, the temperature 100° F. On the fourth evening the patient became delirious, and remained so until her death. About the fourth day also the pulse began markedly to fail. The temperature from this time forward was subnormal. On the day before the death diarrhœa, which had been checked by opium and bismuth, recommenced. The urine was twice tested during the illness, and found to be free from albumen or sugar; it was acid.

A necropsy was made fourteen hours after death; rigor mortis was then strongly present. On opening the abdomen the whole of the alimentary canal gave evidence of having been acutely disordered. The serous surface of the small and large intestine was found coated with a layer of soft, butterlike lymph. The serous surface of the stomach appeared free from this. There were some patches of similar inflammatory product on portions of the peritoneum which lay in contact with the inflamed gut, and in addition there was a small similar patch between the base of the left lung and the diaphragm. The surfaces of the mesentery were free from lymph. There was no free fluid in the peritoneal cavity. In the œsophagus there were a few shallow erosions. In the stomach were found several patches of subserous hæmorrhage, and the mucous membrane was covered with a layer of rather tenacious mucus. The mucous surface of the whole intestine showed signs of recent inflammation, but there was nowhere any sign of chronic disorder. The transverse and descending colon appeared perhaps to have suffered more severely than any other part of the gut. The lungs were emphysematous, the liver rather fatty, and the spleen soft. The heart, kidneys, pancreas, vermiform appendix, and pelvic organs were normal. There was no evidence anywhere of tuberculosis.

It was stated in evidence at the inquest by the chemist who sold the tartaric acid that the poor used tartaric acid very largely in concocting summer drinks, and he further expressed his opinion that a good many of them looked upon tartaric acid and cream of tartar as different names for the same article. The coroner's jury returned a verdict in this case of " Accidental poisoning from an overdose of tartaric acid."

(3) Poisoning by Tannic Acid.

The following is from the *Lancet*, 2, 1903, p. 1728:—

> Dr. F. J. Waldo held an inquest on the body of a man who had died from acute poisoning by tannin. The deceased had fallen into a pit of tanning liquor; death resulted three and a half hours later from violent diarrhœa and vomiting. A similar case was recorded in Germany forty years ago. It would seem that tannin is an irritant poison when taken in large doses.

The editor doubts whether it was simply tannic acid that caused either fatality, as "tanning liquor" would be very likely to contain other substances of an irritant or poisonous nature.

(4) Poisoning by Picric Acid.

Source and Method of Occurrence.—Picric acid is obtained by dropping phenol into nitric acid, heating the mixture and purifying by re-crystallisation ("Extra Pharm.," 1904). It is now becoming a favourite dressing for burns, and toxic effects are produced in this way, but no fatal cases have yet been recorded.

Dixon Mann writes on it as follows:—

Symptoms.—The following case related by Adler (*Wiener med. Wochenschr.*, 1880) illustrates the effects of a toxic dose:—A girl, aged sixteen, endeavoured to commit suicide by swallowing about 300 grains of picric acid mixed with water. Violent pain in the stomach and repeated vomiting speedily occurred, and diarrhœa soon followed; the sclera and the skin were coloured an intensely dark yellow, almost brown; the pupils were moderately dilated and reacted feebly to light; the fingers were spastically stretched and bent at the metacarpo-phalangeal articulations. The urine was ruby-red in colour; it contained neither albumen nor bile pigment; a slight sediment formed which partially consisted of brown-stained epithelium; the stools were fluid and ruby-red in colour. Both urine and fæces contained picric acid in considerable amount; six days after the reception of the poison traces of it were present in the urine. In a few days the discoloration of the skin diminished and the patient was quite well at the end of a week. Chéron (*Journ. de Thérap.*, 1880) relates a case of poisoning from inhalation of picric acid dust, which caused discoloration of the skin, pain in the epigastrium, depression, delirium, vomiting, diarrhœa, and red-coloured urine; recovery took place. In another case symptoms of poisoning occurred from the application of about six grains of powdered picric acid to the vagina; in one hour the skin was discoloured and erythematous, and the urine was red; pain in the stomach and the kidneys with somnolence were amongst the symptoms; recovery took place, but the skin was discoloured for a week, and the erythema persisted for eleven days. A teaspoonful of picric acid has been swallowed without other ill-effect than violent vomiting and purging.

Treatment.—The stomach should be evacuated and well washed out, and elimination promoted by diuretics and, if necessary, aperients; morphine will probably be required to relieve pain and cramps.

Analysis.—Organic matter should be acidulated with hydrochloric acid and digested with alcohol over a water-bath; after filtration the alcoholic extract is evaporated to a syrup, taken up with boiling water, filtered, acidulated with sulphuric acid, and shaken out with ether, chloroform, or amyl alcohol. Dragendorff directs attention to the fact that if chloroform or benzene are used for extraction, the solution, though containing picric acid, will be almost colourless; if ether or amyl alcohol are used they acquire a yellow tint. The extract is evaporated to dryness and the residue dissolved in water and tested.

An aqueous solution of picric acid, gently warmed with a little potassium cyanide, changes to a deep blood-red colour. Ammonia-copper sulphate yields a green precipitate with picric acid. Basic lead acetate gives a yellow precipitate. A piece of white silk allowed to remain a short time in a solution of picric acid is dyed yellow; the colour is not discharged by subsequent washing in water.

Cases.—In the *Scottish Medical and Surgical Journal* for December, Dr. J. Stuart Rose has published two cases in which unpleasant effects followed the use of picric acid as a dressing.

A boy, aged nine years, was scalded on September 15th, 1903, on the left chest and flank. The burn was of the first degree with only one or two small blisters. An ointment composed of picric acid and vaseline (half a drachm to the ounce) was applied on lint. The scalds were dressed daily. On September 18th he was drowsy, there was a slight icteric tint of the conjunctivæ, and the face and palms were a little yellow. The pulse was 120 but the temperature was normal. On the 19th the drowsiness continued, there was vomiting, and the temperature was 101·2° F. On the 20th and 21st the temperature fell to 99° and there was mild diarrhœa. The whole of the skin was yellow but especially that of the face, palms and soles. The hair along the border of the scalp was deep yellow. The urine contained albumen and was of the colour of dark port wine, giving the impression of hæmoglobinuria, but neither blood nor bile pigment was present. The burns were dressed with boric ointment. On the 22nd the vomiting and diarrhœa continued; in the morning the temperature was 103°; in the evening it fell to normal. On the 23rd the discoloration of the skin was less; the burn was sodden-looking. To dry it up gradually a strip of lint two and a half inches by one inch covered with picric acid ointment was applied in the loin. On the 24th there were vomiting and headache and the temperature was 101·4°. There was a bright red blotchy general eruption which was here and there papular. The urine was again deeply coloured. The picric acid dressing was removed. On the next day the rash was fading. In a second case a man, aged forty-five years, scalded his shin and the same ointment was applied. In four days the skin and conjunctivæ were yellow and in six days the urine was like that in the previous case. There were slight diarrhœa and headache. The symptoms rapidly subsided when the ointment was discontinued. Toxic symptoms in these cases appear to have been due to using too strong a preparation of picric acid. It has been extensively used in one per cent. solution without untoward results (*Lancet*, 1, 1904, p. 247).

Another case is as follows:—

A man, aged thirty-five, came to me with the following history and symptoms: On the previous day, at 3 p.m., he took what he at the time thought to be some powdered sulphonal, a drug he was in the habit of administering to himself, but which proved to be picric acid, much used in his trade as a dye. The amount swallowed was a pennyworth, about a tablespoonful. No immediate ill-effects followed; in fact, it was some hours before he found out his mistake.

I saw him on the following morning. He then complained of slight frontal headache, pain over the abdomen and across the loins. He was deeply jaundiced. His urine contained bile and blood. The stools were natural.

Next day the jaundice had slightly diminished, though the abdominal and lumbar pain persisted. In addition there was lachrymation, injected conjunctivæ, profuse mucous discharge from the nares, and sore and irritable fauces. The urine still contained bile and blood.

Three days later he was practically well, though still slightly jaundiced. At no time were the stools paler than normal, but the urine for some days contained both bile and blood.

From the symptoms in this case it would appear that picric acid may be classed with phosphorus, antimony, arsenic, etc., drugs which, taken in poisonous doses, produce so-called hæmatogenous jaundice, due to the action of the toxic agent on the red blood-cells, destroying them and liberating their hæmoglobin. I may add that a medical friend tells me that he has several times noticed distinct jaundice in patients taking medicinal doses of picrate of ammonia (R. Milbourne West, *B. M. J.*, 1, 1896, p. 146).

SUB-GROUP 3.—(1) POISONING BY NITROGLYCERINE.

Sources and Methods of Occurrence.—This is a sweet, oily, powerfully explosive liquid, well known to chemists as a substitution-compound of the innocuous liquid glycerine. It is much used in mining under the name of "blasting oil." It has a sweet aromatic pungent taste, and mixed with an infusorial earth it is known as dynamite. Nitroglycerine in the shape of a one per cent. solution is used in medicine as a vaso-dilator, official dose ½ to 2 minims: it is a type of a class of drugs of which amyl-nitrite and nitrite of sodium are the best known examples, but other organic nitrites have been more or less tentatively used, erythrol-tetranitrate for example (*vide* works on Pharmacology).

Nitroglycerine is the most powerful of the known members of the group, and with the exception of amyl-nitrite the most rapid in its action. It has caused death accidentally in several instances and in the form of dynamite has been used suicidally as an explosive.

The vapour of this liquid acts powerfully as a poison, and even when much diluted with air it produces intense headache.

Toxicity and Fatal Dose.—The pharmacology of these drugs consists in the fact that they all cause in very small doses a rapid dilatation of the small arterioles (*vide* Brunton's "Pharmacology"), which lasts for a greater or less length of time, and their fatal effects are probably due to the consequent fall in blood pressure.

The fatal dose is not recorded, but *vide* below. Mann records a case of suicide by eating two "bobbins" of dynamite four inches long by three-quarters of an inch thick.

Duration.—In fatal cases death is very rapid: thus a man drank some glonoin by mistake and died in three hours; and in other recorded cases only a few hours intervenes between taking the fatal dose and death.

Symptoms.—Murrell has found that one or two minims of a one per cent. solution of nitroglycerine produces painful pulsation over the whole head; the pulsation soon affects the entire body, and is so marked that a pen held in the hand becomes visibly jerked. In five minutes these symptoms are followed by intense headache, languor, and depression.

A man drank a considerable quantity of the liquid in mistake for beer. An hour later he was blue in the face and insensible. When admitted into hospital he was delirious and unconscious, and speedily became comatose. The hands were frequently raised to the head, as if there was headache. The face was red and swollen. He died six hours after swallowing the poison.

Honert met with a case of poisoning by this substance (*Deut. Klin.*, 1867, p. 83). A man took a tablespoonful of gunpowder as a remedy for a boil, and, in order to increase its effect, added a few drops of nitroglycerine. Soon afterwards he was seized with great nausea, and violent and repeated vomiting. According to the patient's own account, he became black about the eyes, had extreme headache and giddiness, and several times became unconscious. There was intense vascular disturbance, and perspiration rolled in streams from the head and limbs. After some time the patient became paralysed; and when seen by Honert, four hours after the administration of the poison, the whole of the voluntary muscles, except those of the face and eyes, were paralysed. In the face and eyes the paralysis of motion was incomplete. The heart's action was retarded, the pulse being only thirty-nine, full and hard. When paralysis was at its height, the breathing became stertorous, and the extremities icy cold. In twenty hours the pulse had risen to seventy, then to ninety in the minute; and the paralysis disappeared. After an attack of catarrh of the stomach the patient quickly recovered.

A miner swallowed two mouthfuls. A painful feeling in his throat made him aware of his mistake, and he drank a quantity of milk. He was not seen by a medical man for an hour and a quarter. He was then suffering from faintness, difficulty of breathing, and oppression at the chest. In five hours vomiting and purging set in. Shortly before death the man lay quietly as if asleep, breathing feebly and occasionally with a deep sigh. The lips were livid before death.

Treatment.—On general principles: adrenalin might be tried as a physiological antidote (*vide* p. 338).

Post-mortem Appearances.—Nothing really characteristic, but in the cases above the following were found:—The brain and its membranes were congested; and there was some yellow serous fluid in the ventricles. The lungs were œdematous, the windpipe, stomach, and kidneys reddened. Signs of irritation were also noted in the small intestines. There were numerous small ecchymotic spots on the fundus and larger end of the stomach. In a second case there was great congestion of the membranes of the brain as well as of the lower lobes of the lungs. The mucous membrane of the air passages was of a red-brown colour. The greater end of the stomach presented a similar appearance with ecchymosis (Husemann's *Jahresber.*, 1872, p. 533).

Analysis.—Nitroglycerine is a heavy, oily-looking liquid. It is slightly soluble in water, more soluble in alcohol and ether. It explodes violently when struck or subjected to concussion. Nitroglycerine yields a red colour when treated with aniline and strong sulphuric acid, and also a red colour when treated with brucine and strong sulphuric acid (free from nitric acid). *Vide* also Brit. Pharmacopœia tests.

(2) POISONING BY AMYL NITRITE.

In the *B. M. J.*, 1, 1898, p. 145, the following case is reported:—

A woman, aged fifty-eight, was under treatment for angina pectoris. She had from six to twelve attacks in the twenty-four hours. Nitrite of amyl inhaled

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(from capsules) quickly relieved the distressing symptoms. Owing to the costliness of capsules, a small quantity of amyl nitrite was obtained, and this was given both internally and by inhalation, but had not the same effect as the capsules, so its use in this form was discontinued.

"On November 24th paraldehyde (two drachms) in water (two ounces) had been ordered. The nurse went to her locked cupboard and inadvertently measured amyl nitrite, the two bottles (though not the labels) being exactly alike. It was only after she had given it to the patient that she realised from the odour and a remark of the patient what she had done. She at once gave the whites of two eggs in one pint of hot water; the patient vomited within five minutes. Meanwhile I had been telephoned to, and had ordered apomorphine gr. $\frac{1}{10}$, to be followed by cocaine gr. $\frac{1}{2}$, and at once visited the patient. I found that after the apomorphine she had again vomited freely; hot water was given, and the vomiting encouraged. At this time, half an hour after the unfortunate dose, the pulse was exceedingly weak, about 130 per minute; respiration very shallow, with long intervals; and temperature as low as 95°—the index had not been shaken lower, so it may have been less than this. The patient was semi-comatose, vomiting liquid smelling strongly of amyl nitrite and having a brown colour. The pupils were contracted, and she was bathed in perspiration. Strychnine gr. $\frac{1}{30}$, followed by ergotinin cit., $\frac{1}{50}$, was given hypodermically, and whisky (two ounces) was given per rectum. The patient's breathing gradually became deeper and more regular, and in about two hours she was in her usual condition after an anginal attack. She said: 'This must have been a very bad one. At the time I was losing consciousness everything seemed green.' Dr. Gibson, assistant medical officer, examined the urine on the following day; there was no sugar present, and no blood corpuscles, but some hæmoglobin was present for twelve hours, as shown by guaiacum test."

Dixon Mann quotes from Rosen the case of a student, æt. 22, who drank some of the liquid, probably about 200 minims, and suffered as follows:—

"Eructations and vomiting occurred. When seen the face was pale, the lips were bloodless, the respirations quiet, and the pulse 110 per minute; he had pain in the head, was much depressed, felt a burning sensation in the throat, and oppression in the region of the stomach. The mucous membrane, touched by the poison, was slightly eroded; gastric catarrh followed, with ultimate recovery. The amount swallowed was from twelve to fifteen grammes."

The editor has had personal experience of an intense headache, lasting some hours, as the result of accidentally inhaling the fumes of the drug, but he is unable to find any further recorded cases of poisoning by it.

(3) Poisoning by Cordite.

The following curious note is taken from the *B. M. J.*, 2, 1903, p. 925. The editor leaves it for reference without comment.

"Whatever may be said of other branches of human knowledge, it can scarcely be claimed that there is nothing new under the sun as regards at least some forms of narcomania. Quite an original species of this vice was discovered by Major Jennings, D.S.O., during the recent operations in South Africa, and the rough notes which he made upon the subject at the time are given by him in the journal of the Royal Army Medical Corps for October. It consists in the eating of cordite with which the Lee-Metford cartridges are charged, and the effects appear to be so unpleasant that it is difficult to understand how the habit should gain any hold upon individuals. Cordite consists roughly of about fifty-eight parts of nitroglycerine, thirty-seven parts gun-cotton, and five parts of mineral jelly; while acetone is used as a solvent, but does not enter largely into the composition. Each cartridge contains sixty cylindrical strands of cordite, each strand measuring one and a quarter inch in length and one-twenty-fifth of an inch in thickness. By way of experiment Major Jennings, after discovering the existence of cordite-eating among a certain number of men, sucked a quarter of a strand for two minutes. He found that the diminution in its size after this time was scarcely appreciable, but nevertheless it caused the most racking, splitting headache he had ever felt in his life, which lasted quite thirty-six hours, and was accompanied by hammering and ringing noises in the ears. Its taste was sweet, pleasant, and pungent. From inquiries among the men, its effects appeared to differ somewhat when sucked and when taken in solution. Dissolved in tea, it produces an almost immediately exhilarating effect, 'inciting to almost demoniacal actions.' If many have partaken of the beverage all begin talking at once, each seemingly anxious to inform the other of everything that has happened to him since his birth. This condition is followed by heavy sleep and stupor, lasting five to twelve hours, according to the quantity taken. To awaken the subject it is often necessary to slap his face, punch or shake him, and awakening is accompanied by severe, dull, boring headache, muscular twitchings, and protrusion of the eyes. Even, however, when fully awakened, the cordite-eater does not seem to realise his surroundings for many hours. It is as an addition to beer that cordite appears to produce its worst effects. It then excites a quarrelsome, destructive mania in an otherwise peacefully-disposed individual, and produces immediate intoxication in a man who can commonly consume as much as four or five pints of beer without exhibiting a trace of having done so. If taken in quantity insufficient to produce sleep it makes him not only quarrelsome, but brings out the worst traits in his character. A possible clue to the inception of this habit is given by the fact that a large number of the men seem to have used cordite as a means of lighting pipes in default of matches. When thus used it gives a sweetish flavour to the tobacco, but causes great dryness of the throat, followed by headache. Others of the men seem to have first tasted the cordite out of curiosity. Major Jennings's account includes notes of communications made to him by various men, in all of which are found statements as to the exceedingly unpleasant after-effects. One of them said that he first became aware of this use of cordite from one of his comrades asking for something to straighten him up because he had been sucking it, and he also observed that some of the men became very elevated after taking a very small quantity of beer, though they could formerly take a large quantity of it without effect. 'Cordite by itself,' said this man, 'does not seem to make men crazy, but only induces a very heavy sleep; but taken with beer or spirits, it brutalises the mildest man and makes a temporary maniac of him.' He also added that he had noticed that it apparently aged a man rapidly, and made him extremely negligent of his personal appearance. The existence of the vice first became known to Major Jennings from the suggestion of a regimental non-commissioned officer that a certain man had possibly been taking cordite in order to escape service; but in concluding his notes Major Jennings suggests that the effects are so exceedingly unpleasant that none but the most depraved would ordinarily resort to it as a stimulant."

(4) POISONING BY ROBURITE.

In the *Lancet*, 2, 1901, p. 1613, will be found an account of a case of poisoning by this substance; it was used in some insect powder.

SUB-GROUP 4.—(1) POISONING BY CREOLIN.

Source and Method of Occurrence.—This substance is thus described in the "Extra Pharm.," 1904:—"Creolin, Pearson, a dark-coloured liquid, antiseptic; said to contain 20 per cent. cresylic acid, with neutral hydro-carbon oil and resin soap."

"In No. 41 of the *Deutsche Medicinische Wochenschrift*, Dr. Pinner, physician to the Jewish Hospital in Hamburg, reports the case of a woman sixty years of age who had attempted suicide by swallowing seventy-five grammes of creolin. It was at first not known which of the preparations called creolin had been taken, but the druggist from whom it was purchased subsequently stated that he only sold Pearson's. The woman was found unconscious in her room, and was taken to the hospital two hours after the attempt on her life. She was then comatose, with livid face, moist skin, and blue lips; her right pupil was larger than the left, and there was no reflex action of the cornea. Her temperature was 36·6° C., her pulse 112 and regular, and her respiration deep and snoring, with tracheal râles. In the pharynx there was a large quantity of white mucus; the palatal arches and the posterior wall of the palate were covered by a grey superficial coating. There was a strong smell of creolin in the breath. By the stomach-pump three hundred grammes of a thick grey fluid mixed with mucus were withdrawn, and pressure on the abdomen caused thick brown drops of pure creolin to come through the tube. The first urine (one hundred and fifty grammes) was of a light yellow colour, without albumen, sugar, or indican; the bromine-water test showed traces of tar acid in it. Microscopical examination revealed nothing abnormal. Milk given through an œsophageal tube was immediately vomited, but was eventually retained. An hour after admission into the hospital there were well-marked symptoms of shock, for which injections of ether were successfully made. There was also copious diarrhœa, and the stools had an odour of creolin. Some hours later the patient regained consciousness and afterwards became better. She complained of severe pain in the epigastric region and in the pharynx. The urine (eighty grammes) was now of a dark green colour, had an odour of creolin, and contained traces of albumen; by the tribromophenol reaction it was estimated that 7·5 c.c. of tar substances were present in 100 c.c. There was no hæmoglobinuria, and only a small quantity of leucocytes and red corpuscles and some casts. The patient slept very well during the first night, and on the following day there was an obvious improvement, the pulse, temperature, and respiration being normal, although she still complained of headache, want of appetite, and hoarseness, and an erosion on the epiglottis, and the arytenoid cartilage was observed with the laryngoscope. On the fourth day there was more diarrhœa, the stools still smelling of tar products. The urine continued for a week to be of a green colour, and contained $\frac{1}{5}$ per cent. of albumen, with much indican. After four weeks the patient was able to leave the hospital in perfect health, and did not show any trace of injury from the poisoning. Dr. Pinner states that this is the seventh case of creolin poisoning described in medical literature, and that it was remarkable for the extremely severe symptoms which appeared almost immediately after the poison had been swallowed. Creolin, he says, used to be considered harmless because it could not be absorbed by the stomach, but in the above case the gastric juice very soon transmuted the creolin into a form which very quickly passed into the circulation and appeared after two hours in the urine. It was very remarkable that the urine of the first four days, even when kept in open glasses, showed neither any growth of bacteria nor any putrefaction, and the normal development of bacteria after exposure to the atmosphere occurred only in the urine passed on and after the fifth day. Dr. Pinner, therefore, suggests that the internal use of creolin may, perhaps, be useful in bacterial diseases of the genito-urinary system, such as pyonephrosis, cystitis, etc. As it also checked fermentation in the bowels, perhaps intestinal derangements attended by extreme fermentation may be successfully treated by creolin. Notwithstanding the alarming symptoms of the first few hours, the patient very soon recovered, the creolin being obviously removed by the kidneys, which, though disordered for a short time, did not sustain any permanent injury. Creolin, therefore, according to Dr. Pinner, must be regarded as a comparatively innocuous substance. Another case of alleged creolin poisoning is reported by Dr. Gras, of Vilshofen, in the *Blätter fur Gerichtliche Medicin.* A tuberculous woman, thirty-five years of age, was treated on the sixth day after confinement with vaginal irrigations of 3 per cent. creolin solution on account of fœtid lochia. After the third irrigation the patient suddenly became collapsed and lost consciousness, the extremities being cold, the pulse feeble, and the respiration shallow; but injections of camphor and other restoratives were very soon followed by recovery, and no traces of carbolic acid were found in the urine. It seems rather doubtful whether these symptoms were due to creolin poisoning or were merely the effects of shock occurring in a woman weakened by childbirth and tuberculosis. There were no positive toxic symptoms, and the quick recovery makes it probable that the seizure was not really due to poisoning" (*Lancet*, 2, 1895, p. 1178).

(2) Poisoning by Lysol.

Source and Method of Occurrence.—The substance is described in the "Extra Pharm.," 1904, as a dark-coloured alkaline liquid obtained by the saponification of kresols, containing the higher homologues of phenol. G. Kluge (*Münch. Med. Woch.*, July 12th, 1898) says that of thirteen cases collected by him four were due to the external application, and nine to internal.

Toxicity and Fatal Dose.—The relative toxicities of carbolic acid and lysol are usually placed at eight to one. Thus, if ten grains is the lethal dose of the former, eighty grains would be that of the latter. There have been four cases of fatal lysol poisoning in children, but none in adults. Lysol is apparently absorbed with difficulty.

Cases.—"Some two months ago a child aged three weeks, whose father had given it lysol instead of a laxative, was admitted to the Foundling Hospital suffering from paroxysms of cough and dyspnœa. The child died next day, and the post-mortem examination, made by Professor Hofmann, gave the following results. The mucous membrane of the lips was greyish, and could be stripped off; the epithelium of the tongue as well as the mucous membrane of the larynx and trachea was swollen; the left lung was consolidated, violet-blue in colour, and injected with blood; the mucous membrane of the anterior part of the stomach was pale rose-coloured, whereas on the posterior part hyperæmia and tumescence were observed. Dr. Haberda, assistant to Professor Hofmann, has shown that the poisonous action of lysol is due to its containing kresols. It cauterises the skin and mucous membrane, and when absorbed it affects the brain and spinal cord, producing unconsciousness, general spasms, reduction of temperature, and bleeding into the uriniferous tubules. He therefore recommends that it should be prescribed only in dilute solution" (*Lancet*, 1, 1895, p. 1221).

The following is from the *B. M. J.*, 2, 1900, p. 1498:—

"On September 10th I was called to one of the schools here to see a European boy, aged fourteen, who had been suffering from 'dysentery' (?) for about one month. At 1 p.m. he had taken an injection of rather less than one and a half ounce of lysol in about a pint of water, using an ordinary Higginson's syringe. At 1.30 p.m. he was found in bed quite unconscious, in which state he remained until my visit at 5.15 p.m.

"He was then in a state of complete collapse, perfectly unconscious, could not be roused at all, lying partly on his side, with the legs drawn up, with pinhole pupils. He was sweating, the pulse was almost uncountable and running, and the breathing rapid, but not abdominal, forty per minute. The temperature was subnormal. The heart and respiratory sounds were normal. The abdomen was not distended and only slightly tense; there was apparently no tenderness on pressure. There was no carbolic smell from the breath or sweat. The anal orifice was slightly discoloured from the action of the lysol.

"The boy was evidently dying. I gave hypodermic injections of strychnine and of ether, which had some slight effect on the pulse. I also washed out the bowel with warm water, which was at first retained, but, on making slight pressure over the abdomen, came away quite uncoloured, but containing numerous white shreds like curds.

"The boy had not been disturbed, when suddenly a quantity (two ounces or so) of dark brown grumous blood was ejected from the mouth and nose (there was no excoriation or discoloration of the mouth), and in five minutes (5.45 p.m.) he was dead. No post-mortem examination was made.

"I have frequently in similar cases (really lower intestinal catarrh) used irrigations with the long soft tube of half an ounce of Jeyes' fluid (creolin) in three pints of warm water, which has been evacuated, and afterwards I have left in, for from two to six hours, a drachm to a drachm and a half of Jeyes' fluid in eight ounces of water without ever having had the slightest ill-effect, and almost invariably with marked benefit. Boric acid used in a similar manner often causes severe headache and bilious vomiting. Lysol is evidently more dangerous." (Hartigan).

Vide also for fatal cases in children *B. M. J.*, Epit., 2, 1898, p. 68, and *B. M. J.*, Epit., 2, 1901, p. 73.

By mistake a nurse gave a woman, æt. 38, suffering from typhoid, some twelve grains of lysol, of which she swallowed ten grains. Five minutes later the patient was markedly cyanosed, and in a state of stupor. The breathing was noisy, difficult, quickened, and irregular. Spasm was at times noted in the extended arms. The pulse could not be felt. Camphor was injected, and the stomach washed out a few minutes later. The wash-water smelt of lysol. The heart's action stood at 160 per minute, and was a little irregular. The pupils were somewhat dilated, and did not react to light. The tongue was dry. The patient began to improve after the camphor injections, but she was still unconscious two hours after taking the poison. She woke up three and a half hours later, and complained of burning in the mouth. Milk and natrium sulphuricum were given by the mouth. She vomited a little later, and the vomit smelt of lysol. The urine contained albumen and casts. The patient ultimately recovered after passing through a further relapse of the typhoid fever. The local symptoms here were not severe. The danger lay in the general symptoms, which consisted of rapid coma and cardiac weakness. The temperature fell rapidly from 39° to 36° C. The symptoms resembled those of carbolic acid poisoning. It is usually said that the difference between lysol and carbolic acid poisoning is that in the former the symptoms do not come on for some little time, but here they appeared in ten minutes; hence no generalisation can be made. The typhoid fever may have accounted for the severity and early appearance of the symptoms. Thus, as with carbolic acid, the symptoms of lysol poisoning may not correspond with the size of the dose.

(3) POISONING BY CREOSOTE.

Source and Method of Occurrence.—It is a product of the dry distillation of wood, and is extracted from the wood tar thus obtained. It has gained for itself a great reputation as an antiseptic for internal use, and also as the nearest approach to a specific yet found for phthisis.

The editor has used it largely, and though he finds that many patients are very intolerant of it (dyspepsia, anorexia, etc.), he has not met with any serious symptoms from its cautious use. As it is, however, a powerful drug with local effects very like carbolic acid, it i likely enough that cases may occur.

The official dose is one to five minims, cautiously increased.

Dr. Taylor records in previous editions that ten drachms of crude "oil of tar" caused the death of a gentleman in 1832, and he states that this was due to the creosote contained in the dose.

Treatment.—As for carbolic acid, *q.v.* p. 405.

Analysis.—Separation from organic admixture is to be effected as is directed for phenol.

Creosote may be recognised by its odour. In alcoholic solution it may be distinguished from phenol by adding a few drops of a solution of ferric chloride; a green colour is produced, which disappears on dilution with water. Phenol similarly treated gives a lilac which does not disappear on the addition of water (Mann).

Cases.—"In the *Intercolonial Medical Journal of Australasia* of October 20th, 1900, Mr. Herbert M. Hewlett relates the following case of creosote poisoning in a child. A girl, aged three and a half years, swallowed about two drachms of creosote. Immediately she complained of abdominal pain and was given a tablespoonful of olive oil. She rapidly became unconscious. About twenty minutes afterwards, when she was seen by Mr. Hewlett, she was insensible, with pale face, cyanosed lips, shallow respiration, and imperceptible pulse. The eyes were fixed, the pupils were contracted and immobile, the extremities were cold, and the muscles were flaccid. The stomach was washed out with about two quarts of warm water. A small quantity of food was present, and the washings smelt strongly of creosote. The stomach was next washed out with two pints of a strong solution of magnesium sulphate, and about six ounces were left in the viscus. Strychnine (one-twenty-fifth of a grain) was injected hypodermically, and she was put in blankets and surrounded by hot bottles. An enema of Liebig's extract and brandy was also given. About eight minutes after emptying the stomach the colour of the lips improved, and the pulse became perceptible. Ten minutes later the colour was good, and the respiration was full and regular. The pupils were still contracted, but reacted to light, and the extremities were warm. In a couple of hours she drank white of egg and milk, but complained of pain over the stomach, which was relieved by hot fomentations. Urine passed many hours after taking the drug was dark brownish. The first motion was also dark and smelt strongly of creosote. A second sample of urine was of a watery green colour. No after-effects followed, and in a couple of days the child was running about again. Creosote closely resembles carbolic acid in its action, but is a weaker caustic, and does not produce convulsions" (*Lancet*, 1, 1901, p. 120).

In the *B. M. J.*, 1, 1898, p. 144, a case of extraordinary tolerance to creosote is recorded. The patient began with one drop three times a day. This was rapidly pushed till he was taking 340 drops a day, and for three months he continued to take from three to four drachms daily; also 100 to 140 drops he took for some months.

(4) Poisoning by Coal-Naphtha.

Source and Method of Occurrence.—The light oily product of the distillation of coal, a hydrocarbon known under the name of coal-naphtha, has caused death in one or two cases.

"A boy, æt. 12, swallowed inadvertently about three ounces of coal-naphtha. He soon appeared as if intoxicated, and ran about in a wild delirium. When seen in a short time by a medical man, he was insensible, and collapsed, breathing stertorously, and his skin was cold and clammy. He had already vomited part of the liquid, and the odour of the vomited matter at once showed what he had taken. By the promotion of vomiting, he was made to eject altogether two tablespoonfuls of naphtha, and partially recovered. In spite of this reaction, however, in about two hours he was again in a state of collapse, insensible, pulseless, gasping for breath, and frothing at the mouth. The eyes were fixed and glassy, and the pupils contracted. There was complete loss of muscular power, and great difficulty of breathing, but no convulsions. He had lost the power of swallowing. In spite of every effort to save him, he died in less than three hours after swallowing the liquid. On inspection of the body four days after death a strong smell of naphtha was perceived throughout the tissues. The blood was fluid. There was slight effusion of serum in the ventricles of the brain. The right side of the heart contained fluid blood, the left was empty; the lungs were not congested, but pale. The coats of the stomach were not inflamed nor materially changed in appearance. This organ contained a pint of semi-fluid matter, of which four or five ounces were liquid. An ounce of a dark-coloured liquid floated on the top, and was easily skimmed off. The liquid appeared to act in this case as a pure narcotic. There were no convulsions. The respiration of the *vapour* of this liquid diluted with air produces headache, giddiness, severe pain in the stomach, loss of appetite, and general illness" (*Lancet*, 1856, 2, p. 230).

"On December 21st, 1900, a little girl, aged five years, was taken to bed by her mother as usual at 6 p.m. The mother at the same time carried upstairs a pint bottle filled with coal-naphtha and placed it on the bedroom floor inside the door, intending to put it away in a cupboard at a more convenient opportunity. She then went downstairs; at eight o'clock she again went up to the bedroom. Her attention was at once drawn to the little girl, who seemed to be breathing with extreme difficulty. Being alarmed at her condition, she cried out that the child was dying. Her husband immediately ran off to procure medical assistance. When I arrived at the house I found my patient in an almost comatose condition, breathing rapidly and with great difficulty. There was a strong, heavy, benzene-like odour in the breath which issued from the mouth and nostrils. The face was dusky and somewhat livid, and the hands were clammy and rather cold. The pupils were dilated, and the conjunctiva was insensitive to the touch. The pulse was rapid and small. On carefully examining the bottle which contained what remained of the liquid I concluded that the child must have taken from between two to three ounces. After injecting a small quantity of brandy with a glass syringe into the rectum the patient seemed to revive a little, and she vomited. A mixture of table-salt and warm water was then administered, which caused her to vomit freely three or four times. The vomited matter smelt strongly of the poisonous liquid, and consisted of partially digested food, together with a quantity of frothy mucus from the air-passages. The lower extremities of the child being next immersed in a foot-bath of hot water, into which a small quantity of mustard had been thrown, I flicked the face with a towel dipped in cold water, and also at regular intervals dashed cold water into her face. Artificial respiration was then performed, and when the livid discoloration had diminished to some extent, the body was inverted for a few minutes in the hope of exciting the respiratory centre in the medulla. External stimulants were also applied to the nostrils. The characteristic odour of the breath persisted for some time, which was possibly due in part to the fact that at the time of her imbibing the naphtha a certain quantity would doubtless have found its way through the glottis. The intensely laborious respiratory efforts, together with the presence of frothy mucus in the air-passages, may to some degree have been ascribed to the same cause. After the expiration of one and a half hours of continued and persistent application of restorative treatment, the child regained consciousness and began to cry. A teaspoonful of brandy in sweetened hot water was then administered, and I left the house. Later in the evening I learnt that she appeared to be going on all right and seemed somewhat inclined to sleep. On the 23rd, about 8 p.m., both parents called at my house and informed me that they thought the child had 'a touch of bronchitis.' I examined the patient the following day and found her to be suffering from acute general inflammation of the air-passages. The mouth and throat were likewise slightly inflamed, and an eruption—resembling herpes—had now broken out on the lips. The bowels being constipated, a dose of two teaspoonfuls of castor oil was prescribed. The chest was regularly poulticed; demulcent drinks, such as milk and barley-water, etc., were ordered; and brandy in teaspoonful doses every four hours was prescribed. The patient, however, gradually succumbed to the acute bronchitis, dying at 1.15 a.m. on January 1st, 1901. An inquest followed in due course" (*Lancet*, 1, 1901, p. 245).

Analysis.—The peculiar odour as well as inflammability of the liquid, and the fact that it burns with a bright yellow smoky flame, would be sufficient to identify coal-naphtha. Its lightness and insolubility in water would allow of its being readily separated from the aqueous contents of the stomach.

(5) Poisoning by Benzene or Benzol.

Source and Symptoms.—This is a colourless volatile liquid hydrocarbon obtained by the distillation and rectification of coal-naphtha. The breathing of its vapour produces narcotic effects, but, according to Snow, with some symptoms indicative of a noxious action on the brain and spinal marrow, *e.g.* noises in the head, convulsive trembling, twitchings of the muscles, convulsions, and difficulty of breathing (*Med. Gaz.*, 1848, N. S., 6, p. 1077). It is poisonous to the lower animals and to all parasites; and it has been suggested by Sonnenkalb as a remedy for destroying the trichina spiralis. This writer also refers to a case in which a quantity of liquid benzene was swallowed by a man, and it operated as a narcotic ("Anilin und Anilinfarben," Leipzig, 1864, p. 13). Gull observed a case of recovery from this poison.

In the *Lancet*, 2, 1900, p. 338, an inquest is reported on a boy who swallowed some ounces of benzoline. He speedily became unconscious, and died in thirty minutes. The case occurred at Burnham, Somerset.

A fatal case is also recorded by Dr. Spurr (*Lancet*, 1, 1899, p. 1488).

Analysis.—The odour and inflammability of the liquid, as well as its insolubility in water, are sufficient to identify it, and to allow of its separation from organic liquids. The boiling point (80° C.) distinguishes it from its homologue toluene (111° C.). By treatment with a mixture in equal volumes of strong sulphuric and nitric acids benzene is converted into nitro-benzene (*q.v.* p. 653).

(6) POISONING BY NAPHTHALENE OR NAPHTHALIN.

Source and Method of Occurrence.—This substance, according to the "Extra Pharm.," 1904, is a solid apparently crystallising out of ordinary coal-naphtha. It occurs in shining white crystalline plates. It is much used for disinfecting urinals, etc. It is, when moulded into blocks, sold under several names—alabastrine, camphylene, albocarbon, etc.

Toxicity.—In the text-books naphthalin is spoken of as a harmless drug occasionally causing pain in the epigastrium and eczema. The tablets in the case below were handed over to Professor Meyer to analyse. He found that each tablet contained two grammes of pure naphthalin; there was no phenol nor camphor present. Experiments on animals showed that naphthalin produced inco-ordination, and partial paralysis when given to frogs; the reflexes were not lost. A rabbit, weighing two kilogrammes, was given from four to five grammes in water; nothing particularly happened until twenty-five hours had elapsed, when the animal suddenly died from paralysis of the nerve-centres; the pulse continued to beat for a short time after respiration had ceased. A cat swallowed four grammes of naphthalin in emulsion form. In an hour and a half the hind limbs became ataxic, and swaying movements of the entire body were noticed, even when the animal was at rest. Attacks of sneezing set in, evidently brought on by nasal irritation; the animal made repeated attempts to remove the source of irritation by rubbing his nose. In two hours' time the inco-ordination had become more marked, and slight twitching movements were noticed in the facial muscles. Saliva flowed freely from the mouth. After four hours, vomiting occurred. The cat died during the night. No pathological lesions were found.

Cases.—The following from *B. M. J.*, Epit., 2, 1899, pp. 114 and 227, are the only cases the editor can find:—

"Evers (*Berl. Klin. Woch.*, 1884, p. 593) records the case of some chronic illness with loss of appetite, headache, and eczema over both legs, which was proved to be due to naphthalin poisoning. In this case the drug was used as moth powder, and was sprinkled over some bedding. The symptoms subsided directly the patient was removed from this particular room, but reappeared when the same apartment was reinhabited. No other cause for the illness could be discovered. Evers had the naphthalin examined, and no impurity was detected. A case of typhoid is reported in which naphthalin was administered by Götze (*Berl. Klin. Woch.*, 42, 1884). The patient was given six grammes during the first three days; after this the dose was increased to seven grammes. On the evening of the sixth day the patient began to be restless, and on the following evening he was delirious. The next day the patient was drowsy. The respiration was laboured and irregular. Lips and face cyanotic. Slight twitching in all the muscles of the body. Pulse regular, ninety-two per minute. The temperature had fallen to normal. The urine was dark brown, and after standing for some time became black. When naphthalin was discontinued, the symptoms vanished in four days. Fronmüller (*Memorabilien*, 1883, 5, 257) saw three cases in which poisonous symptoms had followed the application of naphthalin on wounds. The symptoms began with a sudden onset of fever, headache, and loss of appetite."

"Zangerle (*Therap. Monats.*, February, 1899) met with a case of naphthalin poisoning in his clinic at Marburg. A boy, aged twelve, came home one evening with symptoms which closely resembled alcoholic poisoning. The father was certainly of opinion that his child was 'drunk.' The patient was semi-conscious, his gait resembled that of a drunken man, he was unable to answer questions. The history of the case showed that no alcohol had been taken, but that a school friend had given him two 'bonbons,' which subsequently proved to be the cause of his illness. An emetic was given by the parents, which acted promptly. The next morning the author was called to see the boy, who appeared to be in a drowsy condition, but was quite conscious; there was no vomiting, and the appetite had partly returned. The pulse was regular and full, the reflexes were lively, and there was no sign of paralysis nor incontinence of urine, also no discoloration of urine. The vomiting had so successfully cleared the child's stomach that it was thought unnecessary to give any medicine. The drowsy condition continued during the next four days, and then complete recovery took place. Another boy had taken one 'bonbon,' and had suffered from very similar symptoms, only in a less severe form. The offending sugar-plums were called "'naphthalin camphor tablets'; they were white in appearance, resembling lumps of sugar. They were sold as moth destroyers."

(7) Poisoning by Naphthol Camphor.

Source and Method of Occurrence.—From naphthalin a more or less inert beta-naphthol is prepared. When this is rubbed up with camphor it forms a viscid liquid known as naphthol camphor, described by the "Extra Pharm.," 1904, as a powerful non-toxic antiseptic for wounds.

Notwithstanding its non-toxic properties, at a meeting of the Surgical Society held on May 11th, M. Guinard reported the circumstances of a death which had occurred in his hospital practice very soon after an injection of twenty-five cubic centimetres of naphthol camphor. The patient was a man, twenty-eight years of age, who suffered from a chronic abscess in the right subclavian region. The puncture and injection were made in the usual manner and presented no special feature. The injection had scarcely been given when the patient had a sudden epileptic attack (*épilepsie généralisée*). Believing the symptoms to be of toxic origin, M. Guinard immediately made an incision and allowed the fluid to escape, but the patient nevertheless had two epileptic attacks and died in three-quarters of an hour. In addition to this case M. Guinard mentioned five others, of which two were unpublished and three have been published by M. Netter, M. Menard of Berck, and M. Estor of Montpellier, making a total of six deaths for which naphthol camphor was responsible. He also mentioned fourteen cases attended by symptoms of such severity that a fatal issue was apprehended. The pathogenesis of these conditions was very obscure. No objection could be raised either on the ground of the quality of the liquid, or the dose, or the age of the patients, or the operative manipulation. The only remaining possibility seemed to be a poisonous quality of the mixture of camphor and beta-naphthol, and M. Guinard has come to the conclusion that an injection of naphthol camphor properly administered in a small dose of five or ten cubic centimetres to a healthy adult or child might cause death in a few minutes (*Lancet*, 1, 1904, 1617).

(8) Poisoning by Iodoform.

Source and Method of Occurrence.—This substance, which has been introduced (in the form of yellowish crystals or powder) into antiseptic surgery, is without doubt a poison. Schede, Kocher, and others have published cases where severe and even fatal symptoms have followed its external application. Boyd has still more recently reported four cases where toxic symptoms were developed after its use as a surgical dressing. These symptoms were, in two cases, drowsiness and stupor; in one, those of meningitis; and delirium in a fourth case, which terminated fatally (*B. M. J.*, 1882, 1, pp. 903, 913). Arbuthnot Lane has met with a case of poisoning by its local application to a wound. Mann, "For. Med.," p. 486, quotes two or three fatal cases.

Symptoms and Appearances.—The symptoms usually observed after poisonous doses are—faintness, headache, giddiness, confusion of ideas, burning pain in the stomach, delirium, convulsions, insensibility, general paralysis, a small pulse, sometimes quickened and sometimes slowed, and the skin cold, livid, and bathed in perspiration.

A patient swallowed a quantity of iodoform that had been ordered for external application. Twenty-four hours afterwards he was attacked with violent headache, colic and diarrhœa, which lasted through the following day. On the third day the pains disappeared, though the irritation remained. The breath, too, smelt of iodoform for several days, and a disagreeable taste remained in the mouth for a long time (*New York Med. Jour.*, 1891).

Tuttle (*Boston Med. and Surg. Jour.*, October 8th, 1891) records the case of a woman who, twenty-four hours after using iodoform in her capacity of nurse, developed symptoms of poisoning by it. At first a very fine eruption of macules, papules and vesicles came out on the face, neck, hands and wrists; then followed a diffuse redness with œdema of the eyelids and backs of the hands; the conjunctivæ were intensely congested. The eruption appeared subsequently in all the parts exposed, but was most severe on the hands and between the fingers, where the vesicles became confluent, and, the epithelium having separated, a red oozing surface was left. On the fifth day there was some headache, itching was a prominent symptom, and desquamation took place on the backs of the hands (*B. M. J.*, Epit., 1891, 2, p. 189).

Failure of vision (Brailey) is a common symptom of chronic iodoform poisoning.

Analysis.—Iodine can be liberated from iodoform by nitric acid and extracted by carbon disulphide, which acquires a rose or violet-red colour.

Case.—A man, aged thirty-five years, was admitted to the Swansea General Hospital on March 5th, 1903, with a large non-tuberculous abscess on the calf and the thigh of the left leg. The temperature was 102° F., the pulse was 100, and the general condition was fair. On the 6th the temperature ranged from 98° to 99°. On the morning of the 7th I opened the abscess, irrigated the cavity, and put in a drainage-tube. Whilst my assistant was putting in iodoform quite half an ounce or more dropped accidentally into the large cavity. For twenty-four hours the temperature remained normal. At 8 p.m. on the 8th the patient had a rigor, when the temperature rose to 102°, and two hours afterwards it was 104°, the pulse being 140 and weak and thready and the respirations being 24 and normal in character. The patient, who now became restless and delirious but remained conscious, vomited three or four times. Nothing noteworthy regarding the pupils, the urine, etc., was observed. Quinine and brandy were now administered, and at 12 midnight, when the temperature was 103°, the cavity was washed and swabbed out, the iodoform forming quite a coat. In twelve hours the temperature, which had come down gradually, was normal, the pulse was 120 and fair, and the patient was quiet and sensible. This condition was maintained, the temperature remaining normal, the pulse being 80 and good, and the respirations being 24 (*Lancet*, 1, 1903, 960).

(9) POISONING BY RESORCIN.

Source and Method of Occurrence.—Resorcin, or metadihydroxybenzene, is an artificially prepared organic body, as its name implies, of the benzene series. It is closely allied to carbolic acid, crystallising in colourless crystals, which are readily soluble in water, ether, or alcohol. Applied in the form of crystals, it acts as a powerful caustic to the skin. The commercial resorcin, which is obtained as a by-product in the manufacture of a pigment known as eosin, has a red colour, and a powerful odour resembling that of carbolic acid. It is used internally as a medicine sometimes, but more frequently as an application for the sake of its antiseptic qualities.

Of its **toxicity and fatal dose** but little is known from a medico-legal point of view. On one occasion in which an overdose of two drachms was given to a young woman, it produced decided toxic symptoms—insensibility, profuse perspiration, blanched lips, equal normal pupils, lowness of body temperature, imperceptible pulse, and almost imperceptible breathing. The urine was olive-green in colour. The patient recovered (*Med. Times and Gaz.*, 1881, 2, p. 487). It thus appears that resorcin acts like carbolic acid on the human organism. It is known also to resemble carbolic acid in its coagulating power over albumen and its caustic action on the skin.

Analysis.—Ferric chloride produces a violet colour; sulphovanadic acid blue and then violet. If a crystal of sodium nitrite is mixed with a drop or two of concentrated sulphuric acid and a little resorcin is added, a violet colour, which changes to blue and then brown, is produced (Mann).

Case.—Schwalbe (*Der Kinderarzt*, May 5th, 1899) reports a case of poisoning by resorcin. A girl, aged five years, was ordered an intestinal irrigation of 100 grammes of a ½ per cent. solution of resorcin for gastro-enteritis. By mistake 200 grammes were used (one gramme of resorcin). A few minutes afterwards the child became pale, with clammy perspiration, retraction of the head, and muscular stiffness. She soon became unconscious, and pulseless in fifteen minutes. Medical aid was at once obtained, and ether administered subcutaneously; the colon was washed out with sulphate of soda solution. After ten minutes, consciousness was regained, and the pulse returned. Stimulant treatment was continued, and the child gradually recovered, but was very weak. The urine was dark green and albuminous. The child recovered in a week (*B. M. J.*, Epit., 2, 1899, No. 93).

(10) POISONING BY FORMALDEHYDE.

Source and Method of Occurrence.—Formic aldehyde itself is not used in an undiluted condition, but as a 40 per cent. solution in water, it is then termed formaline, and is being used more and more extensively as a preservative in pathological museums. This formaline at ordinary temperatures gives off a vapour of the aldehyde, which from personal experience the editor can assert is most irritating to the eyes, mouth, and bronchial tubes, and causes most unpleasant effects upon the hands when these come in contact with the material.

It is doubtless a very severe irritant to the stomach. The dose for internal administration is one minim of formaline well diluted.

Case.—Not many cases have yet been recorded of fatal poisoning by it, but the following is taken from the *Pharm. Jour.*, September 3rd, 1899:—

> A young man drank about two ounces of a 4 per cent. formaldehyde solution which was used for treating seed potatoes. The immediate effect was to cause vomiting of matter containing traces of blood, and death occurred about twenty-nine hours afterwards, as the result of heart failure. A post-mortem examination showed that the œsophagus was slightly inflamed, and escharotic changes were visible in the stomach. *Vide* also *B. M. J.*, Epit., 1, 1901, p. 72.

In the *B. M. J.*, Epit., 1, 1901, Nos. 42 and 300, will be found cases of poisoning by this substance.

Analysis.—Apart from the characteristic odour, formaldehyde may be detected in very dilute aqueous solution by the usual aldehyde tests. It reduces ammoniacal silver nitrate. It restores the colour of Schiff's reagent. Owing to its volatility an aqueous distillate suitable for the application of the tests is readily obtained from neutral or slightly acid organic fluids.

SUB-GROUP 5.—(1) POISONING BY ANILINE.

Source and Method of Occurrence.—Aniline, syn. mono-phenylamine or aniline oil ("Extra Pharm."), is a derivative from coal tar. It is an almost colourless liquid, mobile and oily, with a faint vinous odour and aromatic burning taste. It is prepared in enormous quantities for use in the arts, etc., being the origin of the aniline colours so much used for dyeing.

It is occasionally used for suicidal purposes, and accidents occur from the careless storage of it, etc., but the editor is unable to find a homicidal case of poisoning by it.

In the "Archives Génerales de Médecine," Dr. G. Brouardel, of Paris, has drawn attention to cases of poisoning from the cutaneous absorption of aniline. No deaths occurred. The aniline was contained in a boot blacking in the proportion of 90 per cent. Control experiments on rabbits and guinea-pigs furnished corroborative evidence of the facts observed in the human subject, in which the symptoms appeared in from one to four hours (*Lancet*, 2, 1902, p. 1772).

Toxicity and Fatal Dose.—Schuchardt found that a small rabbit was killed by sixty drops in six hours and a quarter, and a large rabbit by one hundred drops in four hours. There was insensibility with loss of heat, and violent clonic and tonic convulsions ensued, which continued until death. From experiments performed, it does not appear to be an active poison as a liquid, and it seems to affect the spinal marrow more than the brain. It has also a local irritant action.

> Turnbull gave half a drachm of the sulphate to a dog. In two hours and a half the animal vomited, and an hour later it was purged. It became dull, weak, and tremulous; the pulse was rapid, and the breathing laboured. The feet were cold, the hind legs paralysed, and the tongue was of a blue colour. In five hours the symptoms abated, and the next day the animal had recovered (*Lancet*, 1861, 2, p. 469).

Letheby found that aniline given to dogs and cats, in doses of from twenty to sixty drops, caused a rapid loss of voluntary power. The animal staggered and fell upon its side powerless, the head was drawn back, the pupils were dilated, the breathing was difficult, and the action of the heart tumultuous; there were slight twitchings or spasms of the muscles, and the animal quickly passed into a state of coma, from which it did not recover, death taking place in from half an hour to thirty-two hours. On inspection, the brain and its membranes were congested, the cavities of the heart were nearly full of blood, and the lungs but slightly congested. The blood all over the body was black and coagulated.

The poison was easily discovered in the brain, the stomach, and the liver, although it was found that, as nitrobenzene is changed into aniline, so in some cases aniline and its salts are converted into mauve or magenta pigment. This arises from the oxidation of the salts, and it has been especially observed on the surface of the body ("Proc. Roy. Soc.," 1863, p. 556). The salts appear to have very little action. They have been used medicinally in large doses, without producing any unusual effects. In one case, 406 grains of the sulphate of aniline were given to a patient, in the course of a few days, without any symptoms of poisoning (Letheby, *loc. cit.*; see also *Med. Times and Gaz.*, 1862, 1, p. 239).

There are facts which show that the *vapour* of aniline, even when much diluted, exerts a noxious effect on man (*vide infra*).

For a full account of the effects of aniline on animals, the reader is referred to a pamphlet by Sonnenkalb, "Anilin und Anilinfarben," Leipzig, 1864, p. 29; also "Watts' Dictionary of Chemistry." The injurious effects to public health likely to arise from the employment of aniline colours in confectionery and cosmetics, are also fully described in this essay.

The dose of aniline sulphate is given as one-half to three grains used cautiously ("Extra Pharm.").

Duration.—Recorded cases seem to show that there is commonly some delay in the onset of symptoms. Recovery is speedy.

Symptoms.—These are commonly of a narcotising type, like those of nitrobenzene, but the very typical feature is the cyanosis which is caused by the absorption into the blood of aniline; this is most marked about the lips and finger nails, and in fatal cases can be recognised in the blood as a bluish discoloration given to it.

A workman accidentally broke a carboy containing a large quantity of this liquid; the aniline fell over him, but none entered his mouth. In his anxiety to wipe up the aniline, he respired the vapour for some time, felt giddy, and complained of his head and chest. When seen some hours after the accident, his face and body were of a livid leaden hue, the lips, gums, tongue and eyes of a corpse-like bluish pallor; his breathing was gasping, and he appeared at the point of death. There was no convulsion; he was sensible, and able to give an account of his feelings. His pulse was small and irregular. Under active treatment he recovered (*Pharm. Jour.*, July, 1862, p. 42; *Med. Times and Gaz.*, 1862, 1, p. 583).

A boy, æt. 16, was brought into the London Hospital in a semi-comatose condition. In scrubbing out an aniline vat he had breathed the vapour; and although he did not suffer pain or discomfort at the time, he was suddenly seized with giddiness and insensibility. When brought to the hospital he looked like a person in the last stage of intoxication; the face and surface of the body were cold, and the pulse was slow and almost imperceptible, the action of the heart was feeble, and the breathing heavy and laborious. After rallying a little, he complained of pain in his head and giddiness. His face had a purple hue, and his lips, the lining membrane of his mouth, as well as his nails, had a similar purple tint. On the next day the narcotic symptoms had passed away, but he was remarkably blue, and looked like a patient in the last stage of Asiatic cholera (*Med. Times and Gaz.*, 1862, 1, p. 239).

These cases appear to show that aniline vapour is less poisonous than that of nitrobenzene, and that the symptoms follow more rapidly on the inhalation of the vapour. Kreuser has noticed among the workers in aniline that they have suffered from intense bronchitis, with a violent dry spasmodic cough, accompanied by ulcerations on the scrotum and extremities. The parts were swollen and painful, and covered with thick black crusts (*Edin. Month. Jour.*, August, 1864, p. 172).

Some of the aniline dyes by contact with the skin have produced much irritation and sometimes an eczema. This subject has attracted much attention in Germany (see Eulenberg's *Vierteljahrsschr.*, 1871, 2, 321). Many mineral substances of an irritant nature are used in the preparation of these dyes, and the articles are not always freed from them by washing. It is now proved that many of the pure dyes are not poisonous.

Treatment.—Empty the stomach as quickly as possible; give stimulants; oxygen inhalations are likely to prove serviceable if they can be given, and artificial respiration may be necessary.

Post-mortem Appearances.—The peculiar blue colour of the blood is very characteristic; beyond this there is nothing to see.

Analysis.—*Commercial* aniline is an oily liquid of a reddish-brown colour, with a peculiar tarry odour. It produces a volatile greasy stain on paper. It is volatile and combustible, burning with a thick, smoky flame. It falls to the bottom of water, and does not readily dissolve in it. It is soluble in alcohol and ether, but only sparingly in chloroform: in the latter property it differs from nitrobenzene. Sulphuric acid combines with it to produce a white sulphate, soluble in water. A solution of chlorinated lime added to the acid watery liquid produces a blue colour, passing into various shades of purple and brown. If a few drops only of a very dilute solution of aniline or its salts be warmed in a test tube with alcohol, caustic potash and a drop or two of chloroform, the unpleasant odour of phenyl isocyanide is evolved.

The solution of sulphate of aniline is not precipitated either by tannic acid or by chloriodide of mercury and potassium; but aniline itself, in the small quantity in which it is dissolved by water, yields, like the alkalies, a yellow precipitate with arsenio-nitrate of silver. It also reduces completely a solution of auric chloride—precipitating metallic gold. When pure aniline is heated with powdered corrosive sublimate, it produces a rich crimson dye. When present in organic liquids, aniline may be separated by digesting the concentrated liquid in alcohol, mixed with a little diluted sulphuric acid. The alcoholic extract, distilled at a high temperature with a solution of potash, yields aniline. This may be detected by the methods above described.

Cases.—For a case of poisoning by aniline oil, see *Lond. Med. Rec.*, 1887, p. 447; also *B. M. J.*, Epit., 1, 1898, No. 142.

The following is taken from the *Lancet*, 1, 1901, p. 1143:—

Dr. St. Clair Thomson read a paper before the Clinical Society on a case of "Poisoning from the External Use of Aniline Oil." Equal parts of aniline oil and rectified spirits having been recommended as a vehicle for cocaine in order to produce local anæsthesia in the ear, Dr. Thomson prescribed a 10 per cent. solution of cocaine in this menstruum for a colleague suffering from furunculosis. A small pledget of cotton-wool moistened with this solution was used at bedtime, and the patient slept well. Next morning, as the pain threatened to return, he again made use of the drops about 5 a.m. At 7.30 a.m., while still in bed, he quite accidentally noticed a peculiar blueness of his finger nails, and his wife remarked that his face was also blue. The face and hands were found to be of a decided dark blue colour, and this was noticeable in the skin under the finger nails and on the lips and tongue. There was no fever nor mental disturbance. The pupils were normal. The respiration was quiet and easy. The pulse was small and somewhat increased in frequency, and when Dr. David Lees had examined the heart the left ventricle was enlarged to two finger-breadths outside the left nipple line. The patient had not previously had any heart trouble, and there was nothing discoverable in the heart or lungs to account for the cyanosis. It was, therefore, ascribed to the toxic effect of the aniline oil on the red corpuscles. The blue colour gradually disappeared in the course of the day. The area of cardiac dulness again became normal, and no murmur was discoverable. Reference was made to a communication made to the Académie de Médecine in July last by M. Landouzy and M. Georges Brouardel describing the cases of ten children who were seized with prostration, pallor, and blueness soon after wearing yellow shoes which had recently been coated with a pigment found to contain 90 per cent. of aniline. When this dye was applied to the shaven surface of the skin of guinea-pigs and rabbits they died asphyxiated in from twenty-four to thirty hours. Some unpublished cases of Dr. Kelynack described similar symptoms, together with gastro-intestinal catarrh and anæmia in chronic cases, among those employed in aniline works.

Vide also *Lancet*, vol. 1, 1909, p. 117, for a case of poisoning by aniline black applied to boots. The solution is apparently very volatile, and workmen suffer by inhaling the vapour when applying it.

(2) POISONING BY NITROBENZENE, OR NITROBENZOL.

Source and Method of Occurrence.—This liquid has a smell resembling benzaldehyde (or oil of bitter almonds sine acido-hydrocyanico, "Extra Pharm."), but the two are very different in other respects, and must not be confounded with one another, though nitrobenzol is used as a substitute for benzaldehyde in cheap perfumery. It is also used very largely in the production of the aniline colours, as it is converted into aniline by acting upon it with acetic acid and iron filings.

It does not appear to have been used homicidally, possibly on account of its nauseous taste and extremely persistent smell, but accident and suicide account for the majority of cases; five cases published by Von Buschow were due to drinking brandy with an uncertain admixture of it (*Berl. Klin. Woch.*, March 4th, 1895), two were fatal and three ended in recovery. In the same journal, Schild records six cases, all in females; two suicidal, both recovered, and four "with intent to procure abortion," this result being attained in three of them, who recovered, but the fourth was fatal before abortion could take place.

Toxicity and Fatal Dose.—The liquid is very poisonous; twenty drops have been known to cause death, but recovery has taken place after much larger doses.

In performing some experiments on animals, Letheby found that the local action on the stomach was slight; there was rarely any vomiting, and there was either rapid coma, or a slow setting-in of paralysis and coma, after a long period of inaction. There was a complete loss of voluntary power, a spasmodic fixing of the muscles of the back, with violent struggles, a look of distress, and occasionally a kind of epileptic fit. The pupils were widely dilated, the action of the heart was irregular, and the breathing difficult.

In 1859, Casper published an account of this liquid under the name of "A New Poison" (*Vierteljahrsschr.*, B. 16, p. 1). Its effects on a rabbit and a dog are here described. Two drachms of it were given to a rabbit without any symptoms being produced; two drachms were then given to the animal at intervals of ten minutes or a quarter of an hour, until the animal had taken one ounce. In a minute and a half after the last dose, the animal fell suddenly on its left side. The pupils were dilated, while the limbs and tail were strongly convulsed. The animal died in a minute. The dose was probably unnecessarily large, but the result shows that nitrobenzene in a large dose may destroy life rapidly. On opening the body, the powerful odour of the liquid was everywhere perceptible, even in the blood. This odour remained strongly in the body when it was again examined fourteen days after death. About five fluid drachms given to a middle-sized dog produced no remarkable symptoms. After some hours the animal was observed to be dull and languid: in twelve hours there was profound coma, with slow respiration and coldness of the skin; but there were no convulsions. The animal was then killed. All the solids and liquids of the body, including the blood, had a strong odour of the poison; and some drops of the oily liquid were separated from the contents of the stomach. The fluid on which it floated had a strong alkaline reaction. The blood retained the odour for several days.

Duration.—The onset of symptoms is often delayed for an hour or more, and death rarely takes place for several hours. In these respects it strongly contrasts with hydrocyanic acid, which its smell suggests. Recovery is very slow (*vide infra*). The time of death in the more rapid cases varied from twenty-five minutes to twelve hours after the administration of the poison. In other experiments, in which smaller doses were given, the time that elapsed between the administration of the poison and the coming-on of the first symptoms (an epileptic fit) varied from nineteen to seventy-two hours; in most cases it was about two days, and the time of death was from four to nine days.

Symptoms.—The usual symptoms are nausea and vomiting, rapidly succeeded or even preceded by faintness and unconsciousness; vertigo and severe headache are common, extreme cyanosis is a marked feature, extending to the finger nails; the pupils become fixed and staring. In fatal cases stupor deepening into coma and death are the most prominent features. In three cases (*Berl. Klin. Woch.*, *loc. cit.*) jaundice appeared on the third or fourth day, with some fever and dark brown urine smelling of the substance and containing albumen. The following cases illustrate the above statements; they tend to show that the vapour is much more potent than the liquid:—

Nicholson (*Lancet*, 1862, 1, p. 135), in referring to a fatal case of poisoning by the liquid, states that he has known several instances in which the *vapour*, as it is evolved from almond glycerine soap, has seriously affected persons. A friend of his who used a cake of the soap in taking a warm bath fainted from the effects of the vapour of nitrobenzene set free, and was ill for some time afterwards. In 1863, a case of poisoning by this compound occurred, in which the symptoms so closely resembled those of essential oil of bitter almonds that it was at first supposed this oil had been taken. A woman, æt. 30, tasted a liquid which had been used for flavouring pastry, and perceiving that it was very acrid on her tongue and lips, spat it out immediately and washed her mouth with water. She thought she could not have swallowed more than a drop, but in replacing the bottle she spilled about a tablespoonful on the table and did not immediately wipe it up. The vapour strongly impregnated the small room in which she was, and produced a feeling of sickness in another servant. The burning taste in the mouth was immediately followed by a sensation of numbness and tingling in the tongue and lips, and a strange feeling for the next hour. The woman became worse, and Fotherby saw her in an hour and three-quarters after the occurrence. Her aspect was then quite like that of prussic acid poisoning: the eyes were bright and glassy, the features pale and ghastly, the lips and nails purple, as if stained by blackberries; the skin was clammy and the pulse feeble. Her mind was then clear, and she described how the accident had occurred, and what her sensations were. She was able to swallow a mustard emetic, after which she became rapidly worse, lost her consciousness, the teeth became set, the hands clenched and blue, the muscles rigid and convulsed. She vomited freely a pale fluid matter, which had the odour of nitrobenzene. The stomach-pump was used, but the fluid washed out of the organ had hardly any odour. The breathing became much reduced, and the pulse could scarcely be felt. In about eleven hours there was reaction, consciousness returned, and she was able to swallow. At the end of seventeen hours she was much better; but she then complained of distorted vision, with flashes of light and strange colours before her eyes. For some weeks she continued weak. It was at first supposed the woman had swallowed a larger quantity of the liquid than she had imagined; but it is obvious, from the entire absence of the odour in the fluid drawn off by the stomach-pump, within about two hours, that but little could have passed into the stomach. There is no doubt, from what has been observed in other cases, that these severe symptoms were chiefly due to the breathing of the vapour in a concentrated form. A fellow-servant who was in the room at the time the liquid was spilled also suffered from the inhalation of the vapour. The liquid was found to be nitrobenzene unmixed with essential oil of almonds.

A clerk in some chemical works took a few drops (supposed to have been fifteen) of nitrobenzene. Immediately afterwards he felt unwell and became insensible. Stimulants restored consciousness, but there was a relapse, and he died the next day (*Pharm. Jour.*, December, 1862, p. 283). A boy, æt. 17, while drawing off some nitrobenzene by a syphon, swallowed a portion of the liquid. There were no immediate symptoms, but he soon felt sleepy, and when at dinner ate but little, and said he felt as if he were drunk. This was between two and three hours after he had swallowed the liquid. He fell into a stupor which became deeper and deeper until death took place, without vomiting or convulsions, twelve hours after the ingestion of the poison (*Med. Times and Gaz.*, 1862, 1, p. 239). The following cases occurred at Maidstone, in 1865. A boy, æt. 13, applied a bottle containing nitrobenzene to his lips. No symptoms followed at the time, and the boy ate his dinner as usual. Some hours elapsed, when he suddenly became insensible. He was almost pulseless, and his jaws were spasmodically closed; the skin of the face was purple, and the lips were livid. He died in about four hours after the seizure, and twelve hours after taking the poison. Some small quantity was most probably swallowed, as the contents of the stomach had a strong smell of the liquid. A cook in the same family also applied the bottle to her lips. It tasted bitter. She had her dinner as usual, but an hour after tasting the nitrobenzene she was seized with vomiting and felt very ill—her lips were black, and her face was purple and white. The woman recovered. The poison had been wrongly labelled oil of bitter almonds. For several cases of poisoning by this liquid, see Husemann's *Jahresber.*, 1872, p. 531; and a paper by Schenk, Horn's *Vierteljahrsschr.*, 1866, vol. 1, p. 32.

Treatment.—The stomach must be emptied by the stomach-pump or emetics as rapidly as possible, and thoroughly washed out. Cold douches and other stimulants may be employed to rouse the patient and prevent stupor. Artificial respiration should be tried.

Post-mortem Appearances.—Nitrobenzol seems to be partially converted into aniline in the body, and this latter body has a peculiar power of turning the blood a bluish colour. Beyond this discoloration of the blood and the powerful smell no naked eye changes are seen on autopsy. When death had taken place within twenty-four hours, the odour of the nitrobenzene was clearly perceptible in the stomach, brain, and lungs; and aniline (from the chemical conversion of nitrobenzene) was found in the organs. In the slower fatal cases the odour had often entirely disappeared; but traces of aniline could be detected in the brain and urine, and sometimes in the stomach and liver. Occasionally no trace of the substance was found, although death had taken place from the poison.

Analysis.—Nitrobenzene, or "essence of mirbane," is a pale lemon-coloured liquid, of a strong odour resembling that of bitter almonds. It has a pungent, hot, disagreeable taste. It gives to confectionery the smell, but not the pleasant taste, of oil of bitter almonds. It gives a greasy stain to paper, leaving a yellow mark when the stain disappears. It sinks in water, and is partly dissolved, giving to it a yellowish colour. It is soluble in alcohol, ether, and chloroform; but when these are agitated with water, it is in great part separated from its ethereal and chloroformic solutions. It has no basic qualities; its aqueous solution is not precipitated by tannic acid nor by the chloriodide of mercury and potassium. It is highly combustible, burning with a yellow smoky flame. It yields no Prussian blue when mixed with ferrous sulphate, alcohol, potash, and subsequently hydrochloric acid; and its vapour produces no cyanide of silver with a solution of the nitrate. It is distinguished from all other liquids, except the essential oil of almonds, by its odour, and from this oil by the following test. Pour a few drops of each on a plate and add a drop of strong sulphuric acid. The oil of almonds acquires a rich crimson colour with a yellow border, the nitrobenzene produces no colour. With a crystal of chlorate of potassium and a drop of sulphuric acid, it yields a violet coloration. In order to separate it from organic liquids, they may be acidulated with sulphuric acid, and submitted to distillation in an appropriate apparatus. If any of it exists in a free state its odour will be sufficient for detecting its presence. It is converted into aniline by acting upon it with acetic acid and iron filings. The aniline may be subsequently distilled over with steam and identified in the aqueous distillate by the tests for aniline (*q.v.* p. 652). There is no probability that this liquid will be successfully employed for the purposes of murder without the certainty of detection.

Cases.—In a paper communicated to the Royal Society in 1863, Letheby described two cases which fell under his observation. In one a man, æt. 43, spilled a quantity of nitrobenzene over his clothes, and went about for several hours breathing an atmosphere saturated with the vapour. The effects were nearly the same in both cases; although in one the poison was inhaled in vapour, and in the other—a youth, æt. 17—it was swallowed as a liquid. For some time there was no feeling of drowsiness in the man; gradually, however, and in about four hours, his face became flushed, his expression stupid, and his gait unsteady; he had the appearance of a person who had been drinking. The stupor gradually increased until it passed into profound coma, and in this state he died. The progress of each of the fatal cases was much the same as that of slow intoxication, excepting that the mind was perfectly clear, until the coming on of the fatal coma. This was sudden, like a fit of apoplexy; and from that moment there was no return of consciousness or bodily power: the sufferer lay as if in a deep sleep, and died without a struggle. The duration of each case was nearly the same. About four hours elapsed from the time of taking or inhaling the poison to the setting-in of the coma, and this lasted five hours.

In 1876, a man, æt. 21, was prescribed three-minim doses of "benzol rect." three times a day. By mistake, the dispenser read the prescription as ordering "benzol nit.," and gave nitrobenzene. The first day he took these doses the patient was observed to look a little pale and weak, but he was not conscious of feeling ill till after taking the seventh dose at 9 a.m. next day. The aggregate amount of nitrobenzene now taken was ascertained to be twenty-three minims. At 2 p.m., five hours after taking this final dose, after walking not more than forty yards in the street from his office, he fell down. He was just able to give his address, and then became insensible. At 3.15 p.m., when seen by Gross, he was cold, and the surface of the body was bluish-purple. There was no pulse, but by the stethoscope the heart could just be heard faintly beating. The lower jaw was rigidly closed; but the limbs were flaccid and dropped powerless when raised; the pupils were widely dilated. No breathing could be perceived for twenty minutes after this. He was treated as for prussic acid poisoning, it being thought that the poison was oil of bitter almonds. At 7 p.m. he became conscious, and complained of headache. At 9 p.m. the skin was still blue. Next day he was fairly convalescent. From the urine collected on the morning following the accident, a substance was extracted having the odour of nitrobenzene.

In 1891, a chemist and druggist took, in mistake, two fluid drachms of nitrobenzene. No symptoms appeared till one and a half hours later when he was at dinner. He was giddy and appeared as if intoxicated, but was able to walk half a mile, though he had not full control over his lower limbs. The stomach pump was used, and liquid having the odour of the poison was removed. He became collapsed and cyanosed, the pulse fell to sixty per minute, and was barely perceptible. Next day he was still cyanosed and passed only one and a half ounces of very dark urine. He recovered, but the cyanosed state of the skin did not disappear till after the lapse of five days (*B. M. J.*, 1891, 1, p. 849).

Lewin has collected fifty-one cases with a mortality of 37 per cent. (*B. M. J.*, Epit., 1895, p. 41).

In the *B. M. J.*, 1, 1895, p. 39, is recorded a case of fatal poisoning by Bellite, a derivative of nitrobenzol.

Poisoning by Phenylhydroxylamine.

The following case is described in the *Deutsche Medicinische Wochenschrift*, of October 14th, by Dr. Hirsch and Dr. Edel, physicians to the Municipal Hospital of Charlottenburg, Berlin. A student of the technical academy, while working in the chemical laboratory, broke a bottle containing an alcoholic solution of phenylhydroxylamine (C_6H_5NHOH), which saturated his clothes and flowed over his abdomen and the inner side of his thigh. He felt at once an intense burning of the skin and retired to the laboratory to apply a cold-water bandage. About fifteen minutes afterwards he was found there in an almost helpless condition, being comatose and pulseless, with stertorous respiration and no reflexes of the cornea or pupils. When he was brought to the hospital the physicians believed him at first to be moribund. The alteration in the colour of the skin was very singular. The lips and mucous membrane of the mouth were greyish-blue, and the skin of the extremities was of an intense blue colour, which contrasted peculiarly with the cadaverous aspect of the other regions. There were also numerous reddish-brown spots on the hands, thighs and abdomen, which did not disappear on pressure with the finger. Respiration was deep and regular, but the cardiac action was extremely weak. Injections of camphor, a hot bath, and other excitants having no visible effect, venesection was performed, and 300 c.c. of dark-brown, chocolate-like blood were drawn off. An intravenous injection of one litre of a solution containing 0·3 per cent. chloride of potassium and 0·4 per cent. bicarbonate of potassium was given immediately afterwards, whereupon the pulse and respiration rapidly improved, and the patient in course of time regained consciousness. He vomited a large quantity of brown-coloured mucous fluid. During the first hours no urine was passed, and the catheter had to be used; the urine thus evacuated contained much albumen and a rather large quantity of casts. During the first day the skin retained its peculiar colour. The patient passed a comfortable night, and on the following day, though still very weak, he felt otherwise well. The pulse became better, the urine was voided spontaneously, and the albumen and casts disappeared on the following day. The lips were now of a pale rose colour, the skin was very pale, and on the third day the normal aspect was restored. The patient soon recovered and was able to leave the hospital. Microscopical examination of the blood proved that the form of the red blood-corpuscles was not changed, but that the hæmoglobin had almost completely left them, and the spectroscope showed that the hæmoglobin was altered into methæmoglobin, to which was due the brown colour alike of the blood, the vomited matter, and the little spots on the skin. The case is very like one of poisoning by nitro-benzol, from which phenylhydroxylamine is derived. The alterations of the colour are characteristic of both drugs, but nitrobenzol never acts as quickly as the other. In the cases of nitrobenzol poisoning hitherto described, the full toxic action did not appear before one or two hours; but in the present case the patient was in a helpless state in fifteen minutes, the poison having been absorbed by the skin only and not by the stomach. The characteristic smell of oil of bitter almonds was also absent. Phenylhydroxylamine is, therefore, a violent poison, which rapidly acts on the blood, the heart, and the kidneys (*Lancet*, 2, 1895, 1261).

SUB-GROUP 6.—POISONING BY PETROLEUM OR PARAFFIN.

Source and Method of Occurrence.—Under the term petroleum, or rock oil, are included various oils used for illuminating purposes, of peculiar odour, which spring from the ground in various parts of the globe; and consist of mixtures of various hydrocarbons and inflammable products. The commercial material is not in its crude state, but is a product purified by distillation from the dangerously inflammable hydrocarbons. The chemical composition of different specimens of petroleum is very varied. Petroleum contains hydrocarbons of the marsh-gas series. Petrol, which is now so largely used for motor cars, is the lightest portion of petroleum. Several accidents from petrol are reported.

The illuminants which were in use prior to the introduction of American petroleum, possess analogous composition, as Solar Oil, Photogene, etc., products of the distillation of bituminous shale and brown coal (lignite), etc. Cases of petroleum poisoning are rare, considering the frequent use of this well-known substance. The majority of cases arise from drinking out of bottles supposed to contain spirituous liquors, although there have occurred a few cases of intentional poisoning by this body; for instance, a case at Brescia (*Jour. de Chim. Méd.*, November, 1866, p. 597), and another in the province of Posen, particulars of which are wanting.

Toxicity and Fatal Dose.—In general the poisonous properties of petroleum, such as the purified American variety, cannot be rated very high; but many varieties of crude petroleum, on account of their containing sulphur compounds, are much more poisonous (according to Eulenberg), as for instance crude petroleum from Canada. In adults a wine-glassful may not kill, and in one case, that of Mayer in Antwerp, five fluid ounces did not cause death. According to Köhler ("Physiol. Thér.," p. 437), half a wine-bottleful is not a fatal dose for an adult. Even in the case of children, among whom the editor has seen several cases, the fatal dose is a very large one; and in the event of death supervening, it is due rather to the secondary result of local action of the poison on the stomach and intestines than to the result of the absorption of hydrocarbons. The lower the boiling point the higher would seem to be the toxicity. Possibly or even probably the difference is due to the amount absorbed, the lighter products being absorbed from the air-passages as well as the stomach. The heavier products are very innocuous.

Symptoms.—The action of petroleum corresponds essentially with that of various ethereal oils, particularly oil of turpentine; and is partly that of a local irritant and partly a remote action on the nervous system. The analogy of the action of petroleum with that of oil of turpentine shows itself also in the skin eruptions which petroleum frequently produces in workmen engaged in petroleum refineries, as well as in the appearance of asphyxia through the inhalation of large quantities of petroleum vapour, where, after the first symptoms of anæsthesia, pneumonia may follow.

In cases of poisoning, generally after vomiting, follow giddiness, sense of fulness of the head, pain and feeling of constriction; and in children, collapse, somnolence, pallor of the face, coldness of the skin, cold sweats, and weak pulse may supervene. Neither the behaviour of the pulse nor the pupils is constant. In collapse, the latter are dilated; and in an excited condition they appear contracted. For the diagnosis, the odour of petroleum in the breath is generally a safe guide. Eructations and vomiting also betray the presence of petroleum. Finally, the urine may acquire a peculiar odour which may persist for several days. In Mayer's case this odour resembled that odour of violets which the urine acquires after the ingestion of oil of turpentine and other essential oils.

Analysis.—The detection of petroleum, either in the vomited matters or in the contents of the stomach, is effected by distilling the suspected matters and determining the physical and chemical properties of the distillate. As commercial American petroleum only contains hydrocarbons with high boiling points, a chloride of calcium bath will be necessary. The notable feature is the peculiar unpleasant odour, and the inflammability of the distillate. Petroleum is insoluble in water and rectified spirit, but is soluble in absolute alcohol, glycerine, ether, and ethereal and fatty oils.

Cases.—In the following case it seems to the editor that suffocation due to aspiration of the paraffin into the lungs, and there acting like water in drowning, had more to do with death than the fact that the substance so aspirated was paraffin.

A child, aged fourteen months, whilst playing swallowed some paraffin oil. She coughed and became unconscious. Four fits, each lasting about three minutes, occurred. They were characterised by rigidity of the limbs, turning up of the eyes, and blueness of the face. Between the fits the rigidity passed off, but the unconsciousness remained. There was no vomiting. When admitted to the Manchester Infirmary the child was much collapsed and was unconscious; the respirations were slow (ten), deep, and sighing; the pulse was fairly good and not much increased in frequency; there was no cyanosis; the pupils were medium-sized and equal; there was an odour of paraffin oil from the mouth. An attempt to wash out the stomach failed, as the eye of the catheter repeatedly became blocked with mucus. Respiration then ceased, and cyanosis occurred. Artificial respiration was carried out, and the cyanosis passed off, leaving the child very pale. The pulse ceased, death taking place one hour and fifty minutes after the swallowing of the paraffin oil. The amount swallowed is stated to have been about an ounce and a quarter. At the necropsy the lungs had the odour of paraffin oil, the œsophagus was slightly congested, and the stomach was very pale and contained much stringy mucus and globules of paraffin oil. The noteworthy points in this case are the convulsions and the absence of the usual irritant symptoms. The former are to be explained, no doubt, by the proclivity to convulsions which exists in infancy (*Lancet*, 1, 1898, 1013, and *Med. Chron.*, February, 1898).

The following case of poisoning by petrol is taken from the *B. M. J.*, 1, 1908, p. 807, by Dr. C. R. Box. In the same journal is a good deal of correspondence on the subject, also another case on p. 987.

A young fellow, in charge of a 40-h.p. Daimler car, returned with the car to a private garage accompanied by another chauffeur. Having taken the car in, they completely closed the garage by pulling down the roller shutters with which it was provided. There was no other opening to the air with the exception of a staircase to the upper storey. The time was about 4 p.m. They then proceeded to manœuvre the car about the garage. For this purpose the engine was kept running, and they noticed a strong smell and black smoke from the exhaust. The younger one stated that a lot of petrol (Carless spirit) was running through the engine. At 4.30, experiencing a sense of vertigo and constriction of the head, "worse than headache," but no nausea, they went upstairs to get some tea. About this time people outside the garage heard considerable shouting and commotion from within, and remarked upon it. At 5.45, on the return of another car, the garage was unlocked, and the two young fellows were found insensible upstairs. One was in the lavatory, which had to be forced open; the other lay near the door of the kitchen. They must have lain insensible for over an hour. The windows upstairs were open. They were immediately carried down into the open and soused with water. I saw them about fifteen minutes later. Both were then in a completely dazed condition, with medium-sized, active pupils. They were unable to stand. One was pale, shivering, and drumming his feet on the floor. He did not appreciate what was said to him, resented interference, and struck out when addressed. The other was deeply flushed and slightly cyanosed. He was more sensible, but when moved he struck out at the door, injuring his knuckles. The pulse in each case was small and rather fast. There had been no vomiting, and the fact that one was found in the lavatory was due to his having taken a pill previously. They were again carried upstairs and laid on settles near the fire. The windows were widely opened. Although warmly wrapped up, they continued to shiver acutely for some time. The shivering had the appearance of clonic spasm, and was particularly marked in the case of the pale patient; the feet in his case and the hands in the other were constantly beating against the floor. The flushed and younger of the two recovered rapidly, the pale one more slowly. By the next day they were both all right, but had only an imperfect recollection of what had happened subsequently to their leaving the garage proper and going upstairs. The treatment adopted was free ventilation and the administration of hot strong tea, which was handy. The kindness of a bystander had already supplied a glass of spirits.

POISONING BY PYRIDINE.

Source and Method of Occurrence.—According to the "Extra Pharm.," 1904, pyridine is a base forming salts with acids, obtained from bone oil and many organic substances by dry distillation. It is contained in the fumes of tobacco smoke. According to Cantani, in his admirable work on therapeutics, pyridine is a strongly alkaline, irritant poison, as well as a drug possessing a profoundly deleterious effect on the medulla, and especially on the respiratory and cardiac centres situated therein. It diminishes reflex irritability, producing slowing of respiration and fall of blood pressure, with nausea, diarrhœa, and profuse sweating. The drug rapidly appears in the breath and the urine. The use of such a powerful poison to render alcohol undrinkable appears to be unnecessary, and it would be well that some less dangerous substance should be used in future (*B. M. J.*, 2, 1893).

Its dose is 5 to 10 minims. The only fatal case of poisoning by it that the editor is able to obtain is thus reported in the *B. M. J.*, 2, 1893, p. 844.

On August 29th, at 10.30 p.m., T. N., aged twenty-nine, a strong muscular man, employed as a stillman at some tar works, was admitted into hospital. He stated in thick guttural speech that he had swallowed "half a cupful" of pyridine bases at 3 p.m. on the same day, and during the intervening seven hours had been at home and vomited five times, the vomited matter having the smell of pyridine.

On admission he was pale, with slightly cyanosed lips and a dry white tongue, and was perspiring freely. The temperature was 103·4°, the pulse 128, weak and intermittent, respirations 40. The breathing was noisy, due to coarse mucous râles.

He complained of tightness in breathing, a choking sensation, pain down the centre of the chest, and pain over the stomach. Demulcents were ordered and given in ʒ j. doses, owing to the patient being unable to swallow more; mustard and linseed poultices were applied to the throat and front of the chest, and an enema of ℥ iij. of brandy given and retained, after which the pulse and breathing improved, and in an hour he could swallow ℥ ss. of milk with ʒ j. of brandy. During this time the expectoration was white and frothy and had the odour of pyridine, as also had his breath.

On August 30th, at 12.30 a.m., the temperature was 104°, but gradually subsided to 99° at 9 a.m. During the night the bowels acted six times, the fæces being partially formed and of a light yellow colour, with no odour of pyridine. ℥ x. of medium straw-coloured urine were passed, with a specific gravity of 1020, no abnormal constituents being detected. At 8 a.m. the expectoration began to be purulent, the odour of pyridine having disappeared. On examination the lungs showed signs of acute congestion and bronchitis, but the patient felt much more comfortable. About 4 p.m. he began to be delirious, the temperature having risen to 104°. He continued wildly delirious, with a temperature varying from 104° to 105·8° all night, until 8 a.m. on August 31st, when he became quieter, and died at 10.15 a.m., forty-three hours after the accident. During the twenty-four hours ℥ ix. of urine were passed, and the bowels acted six times, the motions having similar characters to those of the previous day.

At the post-mortem examination, made twenty-nine hours after death, the epiglottis was found congested on its under-surface. The larynx and trachea were lined by a friable yellow membrane, the large bronchi contained purulent matter, and were lined by a similar membrane. The lungs were congested and œdematous. Nothing was observed about the mouth, tongue, or fauces, but the œsophagus and cardiac end of the stomach were greatly congested, the pyloric end and the commencement of the duodenum being slightly congested. The only changes found throughout the intestines were a few small petechiæ in the small intestine. The liver was of normal size, and showed a few small fatty patches on its upper surface. No changes were detected in the heart, kidneys, or spleen, and no odour of pyridine was observed throughout the examination.

At the inquest it transpired that the man had filled a cask too full of commercial pyridine, which is a colourless volatile fluid, with characteristic odour and taste, used to render alcohol undrinkable. In order to reduce the amount, he obtained a bent piece of iron tube about three feet in length and one inch bore, one end of which he inserted into the cask, and to the other end, in order to start the syphon action, he applied his mouth, and unfortunately drew in the fluid.

Poisoning by Piperazine.

Source and Method of Occurrence.—Piperazine or Diethylene-diamine is an organic base formed by the action of sodium glycol on ethylene-diamine hydrochloride ("Extra Pharm.," 1904). It is a fashionable remedy for gout, and has given rise in an overdose (its dose is usually given as four to ten grains) to toxic symptoms.

In the American *Medical News* Dr. Slaughter, of Philadelphia, relates the case of a young married woman, aged thirty-two, who, through a druggist's blunder, received one dose of piperazine of twenty grains. Some hours later, when the patient was seen by Dr. Slaughter, she was much cyanosed and in a serious comatose condition. The pupils were much contracted, the pulse gave fifty beats to the minute, and the temperature was 97·4° F. The respirations also were slow, and there was low muttering delirium. The tips of the fingers were cyanotic, and there was loss of motion but not of sensation in the lower limbs. Cardiac and other stimulants were at once energetically used, while the limbs were elevated and external heat was applied. A stimulating rectal injection was also given, and the catheter was used. There was paraplegia, afterwards treated by massage and large doses of strychnia. Recovery was perfect (*Lancet*, 1, 1896, 1375).

GROUP 7.—POISONS OF VEGETABLE ORIGIN.

Of all the groups of poisons this is indeed the most artificial from the point of view of action, for it includes illustrations of almost every action of which poisons are capable. Opium acting on the brain, strychnine on the cord, ergot on the vessels, conine on peripheral nerves, primula on the skin, are illustrations that occur to the mind on a most cursory survey. However, the grouping has some convenience for reference, and is here adopted in deference to this convenience. With regard to our British poisonous plants, they all agree in one respect: that when taken in their crude form (bits of leaves, fruit, roots, etc.) they are all very irritating to the stomach, and consequently usually cause emesis, and so provide to a slight extent their own antidote, so far, at least, as that fatal cases of poisoning by them are comparatively rare, but not so far that active treatment by a medical man is rendered unnecessary. In 1901 only five such cases are registered out of a total of fifty-three cases coming under our present group.

The arrangement into natural orders, though very essential to a botanist, is of little use to a toxicologist. It is practically only in the Cruciferæ (every member of which is said to be quite innocuous in all its parts) and in the Solanaceæ (every member of which contains atropine or its isomers) that the natural order determines with any sort of approximation the probable action of the plant. Not only so, but, with the important exception of the Crucifers, there is scarcely a plant growing anywhere some part or other of which will not give rise to very unpleasant, if not fatal, symptoms when incautiously eaten, especially by children, for their constitutions are such as to be readily affected by irritant poison, and they notoriously have a favourite trick of submitting all unknown or attractive articles to the ordeal of taste.

The following brief epitome and sketch of our English flora may be of interest. The sequence is that commonly in use in botanical works, except for the first three-named plants.

Laburnum.—Very common in gardens and shrubberies; not British; the bright flowers and curious pods attract.

Snowball Tree.—Not British; common in gardens; the white fruit, commonly investigated by children, is irritant and depressant.

Horse Chestnut.—Not British, but long introduced. The fruit often tasted by children with alarming though rarely fatal results.

Ranunculaceæ—Buttercups.—Acrid to taste and very irritating and depressant; distinctly noxious. The white water buttercups are nearly innocuous (*vide infra*).

Berberries.—The red berries attract, they are very irritating.

Hellebores.—Luckily rare, and not attractive, irritating and very depressant.

Aconite.—Very depressing, rare as a wild flower, but commonly planted in gardens, and very showy and attractive (*vide* "Aconite Poisoning").

Poppies.—Common and attractive, the plant itself is irritating if eaten, and is likely to cause vomiting (for its after-effects, *vide* "Opium," *infra*).

Celandine.—Fairly common roadside weed, juice very irritant, even to the skin.

Sorrel.—*Vide* "Oxalic Acid"; often eaten as a salad, but is otherwise not very attractive.

Buckthorn.—Fruit like (to children) black currants; irritating, purgative.

Rose Fruits, Blackberries, etc.—Irritating distinctly by the hairs and vegetable matter, no after-effects to be dreaded except constipation.

Bryony.—The white bryony (*Bryonia communis*) is comparatively innocuous, but the black bryony (*Tamus communis*), the berries of which are very attractive on bare hedges in autumn, is irritating and very depressing after absorption.

Umbelliferæ.—The leaves and stems of all are certainly noxious, but the seeds vary very much in their qualities; caraway and coriander are common flavouring objects used in the kitchen; conium seeds are distinctly poisonous (paralysing); cicuta virosa is said to be poisonous in every part; wild celery and parsley should be distinctly avoided; the root of œnanthe crocata (looking like a potato) has very serious paralysing effects. Crithmum (samphire) is used as a pickle; parsnips and carrots both belong to this order, and the wild stock of both are best avoided.

Ivy Berries.—Very irritating.

Mistletoe.—Also irritating.

Privet Berries.—Are distinctly noxious, irritating the stomach and producing severe symptoms of collapse after absorption.

Solanaceæ.—Contain (in some part of the plant) without exception atropine or its isomers.

Solanum nigrum, ,, dulcamera, Atropa belladonna, Hyoscyamus niger, Datura stramonium.	The berries are dangerous to children and attractive; luckily atropa belladonna, the most attractive (cherry-like) fruit and most dangerous, is rare in England (*vide* "Belladonna Poisoning," *infra*).

Potato tops, flowers and seed are dangerous for children to play with.

Digitalis.—The fox-glove is a common native plant with attractive flowers ("Digitalis Poisoning").

Daphne mezereum is very poisonous, but luckily very rare. The flowers in early spring and the berries in autumn may be eaten by children; vomiting and subsequent collapse are the principal symptoms.

Euphorbias.—Are common weeds with an acrid juice, but the whole plant is unattractive and thus rarely gets eaten.

Taxus Baccata.—The yew; the berries when taken whole are very irritating, the red pulp is innocuous.

Urtica.—*Dioica and urens.*—The nettles may be dangerous to children by their stings (introduction of formic acid), producing cardiac failure; when boiled and eaten nettle-tops are without danger—or attraction, I should think.

Orchidæ.—None of the family can be safely eaten.

Liliaceæ.—The bulbs of all these plants had better be avoided, as also the underground knobs of arum maculatum.

Grasses, Sedges, and Ferns may be summed up in general as undesirable food for man, though, except for one or two members (lolium for example is alleged to be poisonous), small pieces may be chewed with impunity, even if the taste does not lead to an immediate spitting out of the plant. At the same time it must be noted that all our grains (wheat, barley, oats, rice, etc.) are the seed of certain grasses.

Fungi.—These, under the guise of mushrooms and toadstools, etc., are rather vaguely divided into edible and poisonous (*vide infra*).

In the following pages the editor has entirely ignored any botanical arrangement and placed the plants in simple alphabetical order, using the Latin name of the genus for that purpose wherever possible.

Poisoning by Aconitum Napellus (and other species).

Source and Method of Occurrence.—The commercial source (*Aconitum napellus*) is not a native of Britain, but is often grown in gardens for its showy flowers. The Pharmacopœia, 1898, directs plants cultivated in Britain to be used for the pharmacopœial preparations.

All parts of the common aconite (*Aconitum napellus*) are highly poisonous. The plant is commonly known by the names of monkshood, wolfsbane, or blue rocket.

In most cases it is the tincture, liniment, or the pharmaceutical preparation which is taken in poisonous dose by misadventure. Still more rarely the active alkaloid, *aconitine*, has been administered. This is perhaps the most deadly known poison, one-sixteenth of a grain having proved fatal, and one-fiftieth of a grain is believed by some to be a fatal dose. The roots, seeds, and leaves of the plant, when masticated, produce a cool numbing sensation, affecting the lips, tongue, and interior of the mouth generally. At first the root appears to be almost tasteless, as the effects are only manifested after the lapse of a few minutes. The sensation, once produced, lasts for several hours.

The roots of *Aconitum ferox*, the Indian bikh or bisch, and those of Japanese aconite from *A. Fischeri*, are also articles of commerce, and are as poisonous as the ordinary *A. napellus*. The official tincture, *Fleming's tincture*, the extract, the alcoholic extract (not official), and the liniment may all be productive of fatal results.

The tincture varies much in strength, the 1898 British Pharmacopœia has much reduced the official strength; its dose is 5 to 15 minims, or 2 to 5 for repeated doses. It is proposed to standardise the tincture to contain 0·025 total alkaloids. Fleming's tincture is six times as strong as the Br. Pharm. tinct.

The root has been eaten in mistake for horseradish, to which it bears a remote resemblance. It has twice been administered for homicidal purposes.

A mistake of this kind led to fatal results in three hours in a case which occurred at Lambeth; and another set of cases occurred at Dingwall, in 1856. Here three persons were poisoned by reason of their having had sauce, made with the root of aconite, served at dinner with roast beef in the place of horseradish sauce. They were healthy adults; and all died within three and a half hours.

Such mistakes show deplorable ignorance, but there is always the risk of their occurrence when horseradish and aconite are grown near to each other in a garden, at that season of the year when the leaves have fallen. A trial for murder by poisoning with the root of this plant took place at the Monaghan Lent Assizes in 1841 (*R.* v. *McConkey*), in which Geoghegan conducted the medico-legal investigation.

The medical evidence was beset with difficulties; for no trace of poison could be discovered in the body, and it was only by a close analysis of symptoms and appearances that the charge was brought home to the prisoner. The deceased had eaten for his dinner some greens dressed for him by the prisoner; he complained of their having a sharp taste, and this was perceived also by another person present who tasted them. It was ascertained that soon after the meal the deceased had vomited some greenish matter, and suffered from purging, restlessness, incoherence, lock-jaw, and clenching of the hands. He died in about three hours after having eaten the greens, but was not seen by a medical man while living. The prisoner was convicted of murder, and confessed before her execution that the powdered *root* of aconite had been mixed with pepper and sprinkled over the greens (*Dub. Med. Jour.*, vol. 19, p. 403).

A liquid sold for external use under the name of **neuraline** appears to be a preparation of tincture of aconite mixed with chloroform and rose-water. According to G. Harley there is one drop and a half of Fleming's tincture in half a bottle of the so-called neuraline. It operates by causing numbness or paralysis of the parts to which it is applied. The same ignorance prevails respecting this as with regard to other poisonous substances dissolved in alcohol, namely, that it is harmless unless the skin is broken. Unless it were absorbed by the skin it could have no medicinal operation, and the effects of absorption must depend on the quantity applied and the frequency with which it is applied. Alcohol has been found to promote the absorption of poisonous agents through the unbroken skin. **Nervine** is also a preparation of aconite.

The case of Lamson, C. C. C., March, 1882, is the only known case of the homicidal use of the alkaloid.

Alarming results have also been known to ensue after the administration of pills, each containing $\frac{1}{250}$th of a grain of aconitine, four times a day. The symptoms were developed on the second day (*Lancet*, 1880, 2, p. 46).

In 1901 no less than five fatal accidents and two suicides from aconite are reported by the Registrar-General.

Toxicity and Fatal Dose.—The poisonous effects of all preparations are due to an active principle, aconitine, about which considerable diversity of opinion still seems to hold, the English and German articles apparently differing materially in activity.

In the cases mentioned on p. 673 as occurring in Holland it was intended to give Friedländer's nitrate of aconitine, a weak German preparation. The dispenser used instead a crystallised preparation procured from Petit of Paris. Plugge, to whom the analysis was referred, found that Petit's preparation was eight times more poisonous to animals than Merck's and a hundred and seventy times stronger than Friedländer's nitrate. He failed to detect aconitine in a benzene extract of the viscera.

Dunstan and Ince re-investigated the aconite bases, more especially the crystalline aconitine obtained from *Aconitum napellus*. This they find to be dextro-rotatory and not lævo-rotatory, contrary to the statement of previous observers; and they assign to it the formula $C_{33}H_{45}NO_{12}$ (*Pharm. Jour.*, 3rd ser., 21, p. 857). Richards and Rogers, on the other hand, are inclined to assume the existence of two isomeric forms of aconitine, differing essentially in their toxicity (*Chemist and Druggist*, 1891, pp. 205, 242).

Of the *root* sixty grains has proved fatal; but it is probable that this is much in excess of the minimum fatal dose. Of the pharmacopœial tincture two or three drachms might probably be fatal. Of *Fleming's tincture* twenty-five minims have killed an adult. Four grains of *alcoholic extract* have proved fatal. Of the [old, not official in B. P., 1898—Ed.] *official* (non-alcoholic) *extract* two grains have proved fatal. It is very uncertain in its action; but is much less active than the alcoholic extract. The *liniment* is stronger than even Fleming's tincture, and eight times the strength of the pharmacopœial tincture: twenty minims would probably form a fatal dose.

The tincture of the root operates powerfully in small doses. Dr. Male died from the effects of not more than *eighty drops* taken in ten doses, over a period of four days, the largest quantity taken at once being *ten* drops (*Prov. Med. and Surg. Jour.*, August 20th, 1845, p. 535. Pereira had known tingling and general numbness of the limbs produced in hysterical women by a dose of only *five minims* of a carefully prepared tincture. Topham has published an account of the symptoms produced by *fifteen minims* of the tincture of the root of aconite.

Immediately after taking the poison in a mixture into which it was put by mistake, the patient (a woman, æt. 27) felt a sensation of numbness in the tongue. with difficulty of swallowing. There were convulsive twitchings of the muscles of the face, and she lost the power of walking. There was complete unconsciousness, which continued for two hours, when she began to recover. The pupils were observed to be slightly contracted. The intensity of the symptoms varied at intervals, and came on in paroxysms. They indicated great disorder of the nervous system. The next day she had numbness in both arms, but she rapidly and perfectly recovered.

From the above cases and others, the remark made above that aconitine is the most powerful poison known would seem to be justified.

Duration.—Death usually ensues within a few hours, but may be delayed. Dr. Male's case is one rather of chronic poisoning. Recovery seems very slow (*vide* a case below, where it took five days).

In 1852, an excise officer lost his life by merely tasting Fleming's tincture of aconite, under the supposition that it was flavoured spirit. He was able to walk from the Custom House over London Bridge, but he died in about four hours after taking the poison.

Symptoms.—Aconite acts powerfully upon nerve terminals and peripheral nerves, and death takes place from its effect upon the cardiac and respiratory nerves and their terminals.

The symptoms met with seem to be practically uniform.

In from three to five minutes after chewing the root of aconite, or after contact of any of its preparations with the tongue, a hot, burning, astringent sensation is experienced on the tongue, extending to the fauces and to the lips, especially the lower. The sensation soon becomes very severe, and is accompanied by a certain amount of salivation, and a sensation of swelling of the fauces, and there may be difficulty in swallowing. The sensation is by some described as one of numbness, and there is decided loss of sensation locally. Later the feeling is one as if the tongue had been seared with a hot iron. Vomiting usually sets in in an hour or two at the latest; and is usually severe and spasmodic. The patient feels cold, especially in the extremities, and the skin is cold, clammy, and perspiring. There may be a feeling of numbness extending over the whole body, or a sensation of impending paralysis.

The symptoms suffered by a friend of the deceased (case of McConkey, above), who had accidentally tasted the greens, were very characteristic of poisoning by aconite. In *two* minutes he felt a burning heat in the mouth, throat, gullet, and stomach; then a sensation of swelling in the face; with a general feeling of numbness and creeping of the skin. Restlessness, dimness of sight, and stupor almost amounting to insensibility, followed; and in about an hour after the meal he was found speechless, frothing at the nose and mouth, the hands and jaws clenched, appearing occasionally as if dead, and then again reviving. Vomiting, purging, tenderness at the pit of the stomach, cramps, tingling of the flesh, and a burning taste in the mouth followed. This man did not entirely recover until after the lapse of five weeks.

In 1856, Hadfield forwarded to the author four small slices of aconite root, taken from the stomach of a man who had died in three hours. The quantity which he had swallowed with suicidal intention was unknown; but none was thrown off by vomiting, so far as could be ascertained. The *symptoms* within half an hour of death were burning pain in the stomach, parched mouth, intense thirst, retching and vomiting of a tenacious mucus, cold perspiring skin, imperceptible pulse, and a feeling of deadly sickness. The patient was conscious: there were no convulsions.

In 1853, a woman took by mistake *seventy minims* of *Fleming's tincture* of the root mixed with one grain of acetate of morphine. In a few minutes she became very thirsty, complained of a burning sensation and pain in her stomach, to relieve which she swallowed a quantity of cold water. In fifteen minutes there was violent vomiting, which continued for two hours. She lost the power of standing, and was very restless. The pain in the stomach increased, and there were convulsive movements of the muscles. She was conscious until shortly before her death, which took place about four hours after she had taken the poison. There were no general convulsions: the pain in the stomach was well marked throughout.

Treatment.—Empty and wash out the stomach if possible.

Digitalin injected hypodermically offers the best chance of an antidote.

Robinson, in the *Bost. Med. and Surg. Jour.*, 1892, reports the case of a soldier who took two drachms of tincture of aconite. An hour later he was extremely collapsed, and at times lapsed into unconsciousness. The stomach was emptied, and twenty-five minims of tincture of digitalis given by hypodermic injections with forty-five minims of sal volatile and two drachms of brandy; recovery took place in about four hours. Hypodermic injections of strychnine may be of use, but strychnine is inferior in its utility to digitalis (Luff).

Post-mortem Appearances.—A slight brown staining of parts of the stomach has been observed; otherwise, there is nothing to be expected or looked for except pieces of the plant. On inspection of the woman above, the membranes of the brain were found congested, but the brain itself was firm and healthy. The lungs were healthy; the heart was flaccid, and the uterus congested. The stomach contained some mucus, and the membrane at the larger curvature was injected (reddened) in patches, but otherwise natural. The mucous membrane of the duodenum was in a high state of inflammation, abraded in patches, softened, and broken down. Some spots were of a very dark colour, passing into mortification.

Analysis.—The botanical characters of the root and leaves, when any portions can be obtained, will enable a medical witness to identify this vegetable poison. The root has been frequently, and fatally, mistaken for horseradish, but there are these striking differences:—1. Aconite-root is very short, conical, and tapers rapidly to a point. 2. It is externally of an earthy-brown colour—internally white, and of an earthy smell—the cut surface is rapidly reddened by exposure to air. It has numerous long thin fibres proceeding from it. 3. It has at first a bitter taste, but after a few minutes it produces a disagreeable sense of tingling and numbness on the lips and tongue. 1. Horseradish root is long, cylindrical or nearly so, and of the same thickness for many inches. 2. It is externally whitish-yellow, and has a pungent odour when scraped. 3. Its taste is sometimes bitter, but it produces an immediate hot or pungent sensation.

The leaves of aconite or monkshood are of a dark-green colour, thick, and of a peculiar shape. When masticated, the leaves slowly produce on the lips and tongue the persistent sensation of tingling and numbness, with the sense of coolness, observed in the root. They are less powerful than the root and seeds. The seeds differ in appearance from those of other poisonous plants. In any suspected case of poisoning by aconite, the vomited matters, or the stomach and intestines after death, should be carefully examined for portions of vegetable matter which may be compared with the structure of the undoubted aconite plant. Aconitine may be extracted from organic liquids by means of Stas's process for the separation of the alkaloids. In this way and by applying the test of taste and that of physiological action on animals (mice) to the substances thus extracted, a very minute trace of aconitine may be detected. No other alkaloid produces the same sensation upon the tongue as the alkaloid, or mixture of alkaloids, known as aconitine. Aconitine yields the general reactions of the alkaloids, and a colour test with sulphuric acid has been described. This colour reaction is, however, valueless, as it does not succeed with pure aconitine, and is due to the presence of impurity. Aconitine readily decomposes when in alkaline solution; and hence it speedily disappears from liquids which remain alkaline, and can no longer be detected. Sir Thos. Stevenson finds that its presence can no longer be detected in viscera where it was known to exist, should these become and remain alkaline for some time from putrefactive decomposition. The active alkaloids, aconitine and isaconitine, seem readily to undergo hydrolysis, especially in alkaline media. Thus aconitine in ammoniacal mixture speedily splits up into another base aconine, and benzoic acid. Wright ("Year-Book of Pharmacy," 1880) and Williams have pointed out the conditions essential for success in the manufacture. In the *Pharmaceutical Journal* for February 15th, 1896, pp. 121 *et seq.*, will be found two papers on the estimation of aconitine by chemical processes. The papers do not permit of condensation, and the reader is referred to them.

In the Lamson case, from a portion of the first ejected vomit—from the urine drawn off from the bladder after death—and from the stomach, stomach contents, liver, spleen, and one kidney, taken together—Sir Thos. Stevenson and Dupré extracted aconitine by a modification of Stas's process. The existence of this was proved by its general reactions as an alkaloid, by the peculiar sensation which it excited upon the tongue, and by comparison of its fatal effects upon mice with those produced by Morson's aconitine. One two-thousandth part of a grain of English aconitine may be recognised by the taste-test, and the same quantity will kill a mouse within a few minutes.

Cases.—A case of poisoning by German aconitine (Merck's) is very crudely recorded. An analytical chemist took eight grains of aconitine after dinner, with suicidal intent. Half an hour later the first violent symptoms appeared. A burning sensation in the mouth and throat first made itself felt, and this became more intense every minute; intense pains in the stomach ensued after thirty minutes, and these became so violent in a few seconds that the patient writhed, shrieking in the most dreadful convulsions, and trying to strike the wall with his head. Very soon he became incapable of swallowing; he was seized with spasmodic cough, and wanted to vomit. In spite of emetics, he could not vomit, however, till an hour after taking the poison, and then with great exertion a dark greenish fluid was ejected; but this afforded no relief to the pain in the stomach, and the burning sensation in the throat, which rendered swallowing difficult. The application of the stomach-pump afforded no relief. Exhaustion ensued after violent convulsions, and the symptoms reappeared with renewed force. At the beginning of the third hour, the pain and convulsions attained such violence that death was expected every instant. In the fourth hour, after repeated injections of morphine, the patient seemed somewhat better. Previous to this he indicated that his skin was greatly irritated. This irritation of the skin, as of ants crawling, continued apparently the whole time, and whenever the intensity of the pains somewhat remitted, he scratched the skin of the face and breast in a convulsive manner till these were sore. His eyes glared wildly, sometimes resting with a fixed stare on one point. The convulsions were repeated at almost regular intervals, and the inclination to vomit continued, although vomiting did not continue after the second hour. At intervals of about forty minutes the patient seemed to lose consciousness, but only for a few minutes, and then the convulsions and other symptoms reappeared with undiminished violence. Three hours after the onset of the symptoms he became incapable of intelligible utterance, but indicated that he felt giddiness; and soon after he appeared to lose sight. He threw himself wildly about on the couch, screamed, and uttered fearful groans. Exhaustion and apparent coma ensued, and then renewed attacks of the most violent description. The difficulty of breathing set in, and he appeared to suffocate. The pulse and body temperature fell considerably, and before death, which occurred at the end of twelve hours, exhaustion and unconsciousness set in, cold perspirations, and death-like pallor. Though death from asphyxia was all along expected, this occurred from syncope. The post-mortem appearances showed nothing unusual. The pupils were dilated, the interior of the mouth was pale, the brain and lungs were congested, the valves of the heart were very flaccid, the liver and kidneys were congested. There was inflammation of the stomach, and its mucous membrane was congested (*sic*). The alkaloid was found by chemical analysis in the contents of the stomach; but, very remarkably, none was found in the urine of the deceased (*Med. Press*, May 24th, 1882, p. 439).

On December 3rd, 1881, Lamson, a medical practitioner, visited his brother-in-law, æt. 19, who was at a school in Wimbledon. John, though a cripple, and paralysed below the pelvic region, was at that time in good health. In the presence of the master, Lamson gave to John a gelatine capsule, which he pretended to fill with powdered sugar, but into which he no doubt introduced a fatal dose of aconitine—perhaps the whole of two grains which he had purchased a few days previously. This was done under the pretence of showing the youth how to use the capsules for taking nauseous medicines. Lamson then made a hasty departure. Twenty minutes or half an hour afterwards the victim was seized with pain in the stomach, which he at first called heartburn, and which he compared to pain which he had experienced on a former occasion when Lamson had given what professed to be a quinine pill or powder. In a box belonging to John there was found, after his death, a packet of quinine powders, some of which were mixed with aconitine, whilst others were free from that poison; and also pills containing quinine and aconitine. There is no doubt that attempts had been made on John's life on two previous occasions by the administration of these articles furnished to his brother-in-law by Lamson. The boy was taken upstairs, and he vomited, and was in great pain. He said his skin felt all drawn up, and that his throat burned. When first seen by Berry one hour and forty minutes after the administration of the poison, he was lying on the bed, with great pain in the stomach. He complained of the skin of his face being drawn, of a sense of constriction in the throat, and of being unable to swallow. He retched violently, and vomited a small quantity of dark brown fluid. Half an hour later he was also seen by Little, and two hours and three-quarters after the poison was swallowed, a quarter of a grain of morphine was injected beneath the skin. This somewhat eased the patient's agony; but the symptoms returned with increased severity. At one time he was with difficulty kept lying down by the united force of two men. An hour later the morphine injection was repeated—one-sixth of a grain being used. Twenty minutes later he died, having been conscious almost to the last. Death occurred four hours and five minutes after the administration of the capsule, and not quite four hours after the commencement of symptoms. At the post-mortem examination, made by Bond, the only unusual appearances were—redness and inflammation of the cardiac end of the stomach, which had a blistered appearance; great congestion of the first portion of the small intestine (duodenum), and patches of congestion in other portions of the intestine in a lesser degree. The brain was hyperæmic. The membranes of the spinal cord were congested. The lungs were much congested, more especially towards the posterior parts. The heart was very flaccid, and as if sodden, and stained with blood-pigment.

The case of the man Hunt, who, in 1863, destroyed his wife and children by prussic acid, presents some features of interest in reference to the symptoms and appearances produced by tincture of aconite. The quantity of tincture taken by him was not determined; but the man was soon afterwards seized with violent spasmodic retching, the face was pale, the skin cold and clammy, the pulse small and hardly perceptible, and the action of the heart feeble. The pupils were much dilated, and the eyes brilliant and sparkling, the breathing quiet and regular, except during the fits. He complained of pain in his heart. In attempting to walk, he staggered, and had no power to raise his arms. He was perfectly conscious, called for writing materials, and wrote a few lines. He then became suddenly worse, and a quarter of an hour before his death he lost all power and sensation in his limbs, the sharpest pinches producing no impression. The pulse was imperceptible. There were no convulsions, but complete relaxation of the limbs at death, which appeared to arise from syncope three-quarters of an hour after he had taken the poison. On *inspection* forty-two hours after death, there was great rigidity of the muscles. The substance of the brain was firm and healthy: the vessels on the surface were filled with blood. The heart was healthy: the right side was greatly distended with dark fluid blood; the left side contracted and quite empty. The lungs were healthy. In the abdomen the viscera were healthy, with the exception of the stomach and duodenum. The mucous membrane of the stomach had a bright red colour at the larger end. There were marks of irritation, with softening and separation of the mucous lining, the whole of the membrane being in a highly corrugated condition. Traces of aconitine were found in the contents of the stomach. The deceased had provided himself with an ounce of the tincture of aconite, and had swallowed the greater part of this mixed with water.

The following note on a case is taken from the *B. M. J.*, Epit., 1897 :—

Robinson (*Bost. Med. and Surg. Jour.*, August 25th) reports the case of a soldier who, after a debauch, took about two drachms of tincture of aconite. He was seen an hour later, when he was recumbent, tossing his limbs about and complaining of numbness and cramps in the arms and hands; his radial pulse was imperceptible, carotid 119, respirations 19, pupils slightly dilated but sensitive, nose pinched, extremities cold, face bedewed with cold sweat; at times he lapsed into unconsciousness. Between one-tenth and one-fifth grain of apomorphine hypodermically produced vomiting, and the stomach was thoroughly washed out by means of a tube. At intervals in the course of four hours—by which time he was out of danger—he was given hypodermic injections, amounting in all to twenty-five minims of tincture of digitalis, forty-five minims of aromatic spirits of ammonia, and two drachms of brandy. Robinson considers that digitalis is far superior to atropine or strychnine as an antidote to aconite, but that stimulants must also be used to gain time for the digitalis to act.

The following is one more illustration of the folly of keeping liniments, etc., in ordinary bottles alongside medicine for internal use :—

On December 12th, Mr. T. T. T., aged seventy-five, about 10.50 p.m., went from his bedroom into an adjoining room with the intention of taking a bronchial mixture, but by mistake took hold of a three-ounce bottle containing equal parts of lin. aconiti, lin. belladon., and lin. chloroform., of which he swallowed twelve drachms before he discovered his mistake. A relative at once administered an emetic of mustard and water.

At 11 p.m. he was found sitting supported on the side of the bed, retching violently. Only slight emesis had occurred. His face, which had an expression of extreme anxiety, was covered with a clammy perspiration, and was drawn and pallid. The pulse was full and regular. He complained of a burning sensation in the epigastric region and extreme suffocation.

Apomorphine one-tenth grain injected hypodermically, followed by one ounce of brandy with water by the mouth, produced emesis in twenty seconds (very slight). As violent retching continued without further emesis, another hypodermic was given, but failed to produce vomiting. His speech now became lost, and the arms and hands were in a state of clonic spasm. They rapidly became fixed tonically, in an arched position in front of the chest, with the hands midway between pronation and supination and the thumbs flexed into the palm. The legs were flexed on the thighs and the thighs on the abdomen.

A hypodermic injection of digitalin, one-fiftieth grain, was now given and a sinapism applied to the cardiac region, but nevertheless the pulse became feeble and irregular and the heart's action weak. He now became unconscious; the pupils were dilated and did not react to light, and there was no corneal reflex. The lips were blue, and the face livid, with frothing at the mouth. At this time, twenty-five minutes after the swallowing of the mixture, the radial pulse became imperceptible and the heart's action very irregular. The body and extremities were cold and clammy, and the urine escaped involuntarily.

A hypodermic injection of twenty minims of ether was administered and artificial respiration commenced, but at 11.30 p.m. the patient expired (*B. M. J.*, 1, 1896, 399).

The following case (*Lancet*, 2, 1897, p. 1466) is well worth record on account of (1) its connection with quackery and (2) the difficulties of estimating aconitine :—

At an inquest held not very long since the jury returned the following verdict: "The deceased man died from cardiac failure produced by a poisonous dose of aconite contained in a bottle labelled Wallace's Specific No. 1." As a sequel to this finding the Treasury instituted a prosecution against Wallace, who is described as "a homœopathic practitioner." Upon conviction he was fined in all £20 12*s.* for selling a poisonous drug to a person not known to him without inquiry, without entering the fact of such sale in a book, and without being a chemist registered for the sale of such drugs. On that occasion Dr. Luff, one of the official analysts to the Home Office, deposed that an ounce bottle contained one twenty-seventh of a grain of aconitine, and that a sixth part of an ounce might prove fatal. On November 12th a second Treasury prosecution also resulted in a conviction, and the sum total of the fines amounted to £62 16*s.* The so-called "Specific No. 1" is a patented medicine, prepared according to the specification which was submitted to the Patent Office on March 3rd, 1897, and accepted on May 1st, 1897. In this specification the following statement occurs: "It [the invention] consists of a new method of preparing a watery alcoholic tincture of any part of the plant called aconite, which shall retain its curative physiological properties without the greater part of its toxic elements. The chief poisonous alkaloid or principle of aconite is aconitine, and by the method of preparation hereinafter to be described its toxic properties are wholly, or in great measure, eliminated whilst its curative value remains." For the defence it was alleged that the method of preparation ensured the destruction of aconitine or its being broken up into comparatively harmless substances, and in support of this contention direct evidence was given by Mr. Wynter Blyth, public analyst to the parish of St. Marylebone, who stated that as a result of his analysis he found 0·09 grain of an alkaloidal residuum from an ounce bottle of the specific, that this residuum had a bitter taste, and reduced the salts of silver, characters not possessed by aconitine. He concluded that the residuum was a mixture of benzoil-aconine—a very small portion of *aconitine* and a little aconine. There was about $\frac{1}{1000}$ grain of aconitine in the one-ounce bottle. The results of Dr. Luff's analysis varied from those of Mr. Blyth to a singular degree. From an ounce bottle examined in January, 1897, he extracted $\frac{1}{27}$ grain of aconitine. From an ounce bottle analysed in July, 1897, he obtained $\frac{1}{23}$ grain of aconitine; whilst from a like quantity of the "specific" made by him according to the specification the yield of aconitine was $\frac{1}{20}$ grain. Dr. Luff has had almost unrivalled experience in the study of the chemical nature and other properties of aconitine, and his official position is a warranty of his scientific attainments and reliability. It is, moreover, remarkable that the results of his three analyses should have so closely coincided, the quantity of aconitine to the ounce varying only from $\frac{1}{20}$ to $\frac{1}{27}$ grain. As there is no known trustworthy chemical test for aconitine Dr. Luff resorted to physiological experiment. He found that $\frac{1}{500}$ grain of the alkaloid extracted from the contents of the ounce bottle of the "specific" killed a mouse in eighteen minutes with the symptoms of aconitine poisoning. To check the results of the experiment he at the same time injected into another mouse of the same weight and the same species the same weight of ordinary aconitine. The animal succumbed in the same time and in like manner as the other. It is not necessary to call into question the results obtained by Mr. Blyth to prove the accuracy of Dr. Luff's deductions. It is quite possible to accept both as substantially correct. Such a course would, however, lead to the conclusion that the contents of the different bottles of the "specific" varied enormously, and to a degree which showed that no reliance could be placed on the alleged composition of the contents of a particular bottle offered for sale to the public; that in fact the so-called remedy can be looked upon in no other light than as a mixture dangerous to human life. To contend that the Patent Office approved of the specification, and that, too, without objection from the Pharmaceutical Society, goes for nothing in extenuation. The patent was granted on the assumption that the mixture did not contain the poisonous properties of aconite, and any inaction on the part of the Pharmaceutical Society cannot be taken even as a tacit admission of the harmlessness of the "specific." The public need protection, and we heartily congratulate the Home Office on their thorough exposure of a miserable piece of quackery and illegality.

In the *Lancet*, 1861, 2, p. 170, it is stated that a lady recovered who had swallowed two teaspoonfuls of tincture of aconite by mistake for laudanum, which she had been in the habit of taking in large doses. After she had swallowed the aconite she could not rise from her seat, and exclaimed that she had lost the use of her legs. She complained of a burning sensation in the throat and constriction at the chest. Her mind was clear, and she had no feeling in her arms and legs. The symptoms subsided in two hours, and she recovered in eight hours. Vomiting had been early promoted by emetics. In 1862 a man died from the effects of two grains of extract of aconite taken in two pills. As in other cases in which active poisons have been administered in pills, the symptoms were a long time in appearing, but when they once commenced they proceeded rapidly to a fatal termination.

In 1880 three cases of poisoning by crystallised nitrate of aconitine occurred in Holland (Schmidt's *Jahresb.*, 189, p. 122; *Berl. Klin. Wochenschr.*, 1880, p. 337), and one of them proved fatal. The first was the case of a weakly man, sixty-one years of age, suffering from chronic bronchitis and a febrile attack. For this there was prescribed a solution of nitrate of aconitine. The patient took five drops, containing ·006 of a grain of the nitrate, at 7 p.m. This produced an astringent and burning taste in the mouth, extending to the stomach. At 9 p.m. the dose was increased to twenty drops (= ·025 of a grain); and this dose was repeated at 8 a.m., 11 a.m., 4 p.m., 9 p.m.; next day, at 10 p.m., a final dose of ten drops (= ·012 of a grain) was taken. In all one-seventh of a grain of the nitrate was taken in seven doses. After each dose the patient was seriously indisposed, so that eventually his life was in jeopardy. The symptoms were a feeling of coldness, cold clammy perspiration, severe vomiting, difficult respiration, great lassitude, and the patient felt as if he were about to become paralysed. There were intermittent deafness and blindness, and spasmodic twitchings of the whole body, but more especially of the muscles of the face. At one time he felt that he was dying, and stated that he had been poisoned. The respiration became stertorous and quickened; then slow and gasping. There was no loss of consciousness. It is not stated that there was any loss of sensation, or any actual paralysis.

In the second case, a man, æt. 62, took an undetermined dose of the same medicine. When seen he had cold clammy perspiration, a weak, irregular, dicrotic pulse, and was conscious. The respirations were short, laboured, irregular, and superficial. The pupils were contracted, and responded feebly to light. There was no difficulty in swallowing. There was great precordial anxiety, and *facies hippocratica*. Suddenly the pulse entirely ceased, though the cardiac beats could still be feebly heard; and a deathly pallor supervened. The patient rolled from side to side of the bed. The pupils were now dilated. Tonic convulsions of the facial muscles set in, with trismus; then three hours after the dose general clonic convulsion, and the patient lost consciousness. In five or six minutes muscular relaxation ensued, but the convulsions returned in a quarter of an hour. An hour later death appeared imminent. Vomiting now set in, the pulse improved, and in twenty-one hours the man was convalescent.

The third case terminated fatally. Dr. Mayer, who had prescribed for the above patients, himself took from fifty to sixty drops of the solution of nitrate of aconitine prescribed for the first patient. This corresponds to one-thirteenth to one-twenty-first of a grain of the nitrate. It may be assumed that the dose was probably one-sixteenth of a grain. The symptoms commenced in an hour and a half; but they were not accurately noted till 8 p.m., four hours after the alkaloid had been taken. He was then found with a small, weak, irregular, but not slow pulse, cold skin, and contracted pupils. He had an astringent and burning pain in the mouth, extending to the stomach, and difficulty in swallowing. The tongue was swollen. There was great precordial anxiety. He complained of burning pain, weakness, and heaviness of the limbs—especially the lower—which felt cold. Suddenly vision was lost, and the pupils became dilated. Soon, however, they again contracted, and vision was restored. Vomiting was procured by tickling the fauces. At 4.40 p.m. severe convulsions first set in, with stertorous respiration, singing in each ear alternately, and deafness. Ether was employed hypodermically, and its use was followed by renewed vomiting and convulsions. The pulse nevertheless, improved, and ether was again injected. In a few minutes there was renewal of severe vomiting and convulsions, and the patient became unconscious; the pulse failed, and death ensued at 9 p.m., without return of consciousness, five hours after the administration of the fatal dose. On post-mortem examination the viscera were unusually charged with blood, and there was considerable hyperæmia of the stomach and small intestines, so that the colon and rectum appeared pale and bloodless by contrast. The intestines contained fæces, there having been no stool passed during the illness; and the bladder contained two and a half ounces of urine.

Poisoning by Æthusa cynapium (Fool's Parsley).

Source and Method of Occurrence.—Fool's parsley, or lesser hemlock, is common in gardens in some districts. The leaves so closely resemble those of parsley that they have often been gathered for them by mistake.

That the root of this plant contains a most energetic poison, and that it is capable of producing rapidly fatal effects, is apparently shown by a case in which death took place in an hour.

A girl, aged five years, in good health, ate the bulbs of the æthusa by mistake for young turnips. She was suddenly seized with pain in the abdomen, followed by sickness, but no vomiting. She complained of feeling very ill. On trying to eat, she could not swallow. She was incapable of answering questions, and her countenance bore a wild expression. The lower jaw was so fixed by spasm as to prevent anything being introduced into the mouth. She then became insensible, and died in *an hour* from the commencement of the symptoms; so far as could be ascertained, there were no convulsions. A second child, aged three years, shortly after eating the same substance, was attacked with pain in the stomach, sickness, vomiting, and profuse perspiration. She soon recovered, with the exception of suffering severe griping pains without purging, but these disappeared on the following day. A third child, of the same age, suffered from similar symptoms. Recovery in the last two cases was due to the plant having been eaten on a full stomach, and to the effect of early and copious vomiting (*Med. Times*, August 23rd, 1845, p. 408). [The Editor leaves these cases as originally published by Dr. Taylor, but it is quite obvious to any botanist that the plant eaten was *not Æthusa cynapium*, for it has nothing like a bulbous root.]

Two ladies partook of some salad, into which the leaves of this plant had been put by mistake for parsley. They soon experienced nausea, with occasional vomiting, oppressive headache, giddiness, and a strong propensity to sleep, at the same time this was prevented by frequent startings and excessive agitation. There was a sensation of pungent heat in the mouth, throat and stomach, with difficulty of swallowing, thirst, and loss of appetite. There was numbness, with tremors of the limb. The two patients only slowly recovered from the effects of the poison (Churchill's "Botany").

Dr. John Harley has published experiments (St. Thomas' Hosp. Rep., 1873, p. 43) which show that fool's parsley is not a poison. Although the particular plants he experimented with were not poisonous, there is evidence to show that other specimens—if rightly named—are highly poisonous. The editor is inclined to think that danger from the plant is overrated, as it is not particularly common, nor is it a showy nor in any way an attractive plant, nor commonly recognised by those who are not botanists.

Analysis.—It is known from garden parsley by the smell of its leaves when rubbed, which is peculiar, disagreeable, and very different from that possessed by the leaves of parsley. The leaves of fool's parsley are finer, more acute, and of a darker green colour. Its flower-stem, which is striated, or slightly grooved, is easily known from all other umbelliferous plants by the beard, or three long pendulous leaves of the partial involucrum under the flower. The flowers are white; those of the garden parsley are of a pale yellow colour.

Case.—The following, reported by Dr. Davison, in the *B. M. J.*, 2, 1904, p. 124, requires verification as to the identity of the plant:—

> On July 1st, 1904, I received a message to attend E. W., aged twenty-three, domestic servant, and found her to be suffering from severe abdominal pains with persistent vomiting and diarrhœa. The vomited matter was green-stained. The patient was extremely collapsed, surface cold, radial pulse absent, heart beating at the rate of 120 times a minute, heart sounds very feeble. The temperature was so subnormal as to be incapable of being registered by the ordinary clinical thermometer—the mercury not rising to the 95° F. graduation mark. On inquiry I elicited the fact that on the previous day the patient had eaten a considerable quantity of a herb gathered in the kitchen garden attached to the house, which she believed to be "mustard and cress." This proved to be "fool's parsley" (*Æthusa cynapium*) of very young growth. The symptoms of poisoning did not come on until some twenty hours after ingestion.
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> Morphine (for the pain) and stimulants were administered, and the patient made a speedy recovery.

POISONING BY ALOES (SP. VAR.) AND OTHER VEGETABLE PURGATIVES.

Source and Method of Occurrence.—These different substances, which are used in small doses as medicines, are liable, when taken frequently or in large quantities, to excite vomiting, purging, and other symptoms of irritation. Colocynth has occasioned death in several instances: in one case a teaspoonful and a half of colocynth powder destroyed life; and one drachm of gamboge, a medicine much used by quacks, has proved fatal to a man (Traill's "Outlines," p. 150). Aloes and colocynth mixed are said to be the basis of the quack medicine sold under the name of Morison's Pills. These have proved fatal in many instances from the exhaustion produced by excessive purging from the large quantity taken in frequently repeated doses. Our knowledge of the symptoms and appearances produced by these irritants is, indeed, chiefly derived from the cases which have proved fatal under this treatment. In the seventeenth volume of the *Medical Gazette* will be found four cases of this description. The most prominent symptom is excessive purging, with the discharge of large quantities of mucus; the individual becomes exhausted, and slowly sinks. In some instances the symptoms are those of inflammation and ulceration of the bowels. In 1836, a man was convicted of having caused the death of a person by the administration of these pills; in this instance the death of the deceased was clearly due to the medicine, and on inspection the stomach was found inflamed and ulcerated; the mucous membrane of the small intestines was inflamed and softened, and there was the appearance of effused lymph upon it. Holloway's Pills are of a more innocent description; the principal ingredient in them is aloes. In all cases it must be remembered that these drastic purgatives may cause serious symptoms, or even death, when administered to infants, or to persons debilitated by age or disease; and it is not necessary that the dose should be very large in order that the fatal effects should follow. The question here will be, whether the medicine caused death, or whether it simply accelerated it, although in a legal view that which accelerates causes.

Hierapicra (*Holy Bitter*) is a popular aloetic compound, and one death is reported to have been produced by it in 1837–8. There is reason to believe that it is occasionally used for the purposes of procuring criminal abortion. A man was tried and convicted of this offence (Aylesbury Lent Ass. 1857, *R.* v. *White*), and the noxious properties of this compound then became a subject of inquiry. The dose, and the condition of the woman to whom it is administered, will of course affect the answer to this question. At the trial above mentioned, it was probably considered to be a noxious substance within the meaning of the statute. The fact that, under the name of *Pulvis Aloes cum Canellâ*, it was formerly admitted into the British Pharmacopœias, cannot justify the mischievous uses to which it may be put. *Hierapicra* is a snuff-coloured powder, of an intensely bitter taste. It consists of four parts by weight of aloes, and one part by weight of powdered canella bark. The proper medicinal dose was formerly fixed at from five to fifteen grains. Its injurious effects on pregnant females are chiefly due to the aloes. This specially affects the rectum, and by contiguity, under violent irritation or purging, may affect the uterus. From the taste and colour which it imparts to liquids, it is not probable that it could be taken by a female unknowingly.

Death has been caused by aloes taken in nitric acid; but in this case the mineral acid was most probably the destructive agent. A singular case occurred in Germany, where a medico-legal question was raised respecting the poisonous properties of *aloes*. A woman, æt. 43, not labouring under any apparent disease, swallowed two drachms of powdered aloes in coffee. Violent purging supervened, and she died on the following morning, twelve hours after having taken the medicine. On inspection the stomach was found partially, and the small intestines extensively, inflamed. There were no other particular appearances to account for death, and this was referred to the effect of the aloes.

Arrow Poisons.

These perhaps hardly come within the range of a work on medical jurisprudence, for luckily the use of poisoned arrows is confined to certain tropical native races, but Dr. Stockman, of Glasgow, delivered an interesting address on them in 1898 to the North British Branch of the Pharmaceutical Society, which is worth the reader's attention. It is contained in the *Pharm. Jour.* for 1898, pp. 550 and 585 :—

> He states that the bushmen in South-West Africa use local poisons differing in different districts. He mentions, on the authority of Baines, a poison made by smearing the entrails of a caterpillar on the arrow point, "the action of which has a generic resemblance to snake poison." Other tribes use the amaryllis disticha, various species of Euphorbium and Acokanthera, alone or mixed with snake, spider, and beetle poisons.
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> The Choco Indians, in Columbia, South America, also use a peculiar poison, derived from a tree-frog, the *Phyllobates chocoensis*, which they hold on a stick near

a fire, when the heat causes the glands of the skin to secrete the poisonous fluid. The Choco Indian poison is innocuous when given by the mouth ; a few experiments have been made with it in France, but its exact action remains rather doubtful. It is capable of killing large carnivora.

The most deadly are the arrow-poisons derived from the root wood of different species of *Acokanthera*, trees about fifteen feet high—*A. schimperi*, *A. deflersii*, and *A. ouabai*. From these is prepared the deadly arrow-poison of the Somalis, known now for a long time and very fully described by Burton ("First Footsteps in East Africa," 1856). The poison is known as Waba, Wabayo, or Ouabaio. It is a thick tar-like, watery extract, the active constituent in which is a glucoside known as ouabain (Arnaud), and it is made by splitting up the root into small pieces, boiling these with water, inspissating the juice, and then adding usually snake-venom or other poisonous vegetable extracts. Burton says that cattle eat the leaves of the tree only if very hungry, and that the berries are edible.

Besides the Somalis, the Wa Nyika, Wakamba, the Massai Wa Nyamwesi, and many tribes of Eastern and Central Equatorial Africa use practically this same poison, although there are many minor differences in its composition among these different peoples. Many of the prepared poisons contain very irritating substances, which are productive of severe local symptoms in the wounded. Boehm states that the poisonous dose for a dog per kilo. of its weight is about $\frac{1}{140}$th grain echujin, $\frac{1}{260}$th grain strophanthin, and $\frac{1}{430}$th grain ouabain, which gives some idea of their extreme toxicity.

In German South-West Africa the Ovambas also use a heart poison derived from a species of *Adenium*, while the *Strophanthus* is widely used on the Congo, on Lake Nyassa, the Zambesi, Gaboon, Guinea, Cameroons, and Senegambia. Various *Euphorbias* and other imperfectly known plants are also largely employed.

Mr. Crawford Angus gives a graphic account of the poisons used in Azimba and Chapitaland in Central Africa. The natives use an arrow, the slightest scratch of which causes death, the poison being known only to certain chief men, who collect it and serve it out to the others.

The arrow poison of the Pigmies is a mixture of a cardiac poison and strychnine poison, with some others. It is very deadly, and one arrow will kill an elephant, but Stublman states that in man, if the head be at once extracted and the wound scraped and washed, fatal consequences are frequently averted.

Another set of arrow poisons which have a similar action on the heart are those made from the juice of the famous upas tree, the *Upas antiar*, growing in Borneo, Java, and adjacent parts. It is a very large forest tree, and the poisonous sap is obtained from incisions made into the bark. The active principle—a crystalline glucoside called antiarin—is extremely poisonous, and experiments which I made with it showed that ·00015 gram was sufficient to kill an ordinary-sized frog in comparison with ·00022 gram strophanthin and ·00037 gram urechitin. The sap is known as Ipoh Kayu (tree poison) among the natives. It kills guinea-pigs and other small animals in a few minutes from stoppage of the heart, and has been used in Cochin China against the French soldiers, who died in from half-an-hour to several days after receiving their wounds. It is in use throughout the Eastern Archipelago by nearly all the native peoples, pure, or mixed with snake-poison, scorpions, centipedes, other plants, and occasionally with arsenic. The different prepared poisons vary greatly in strength, and one old specimen which I examined was quite innocuous.

Aconite root (*A. ferox*), under the name of Bis, Bish, Bikh, and sometimes called tiger poison, is used as an arrow poison in Nepaul and along the eastern frontiers of our Indian Empire, and on the French and Chinese frontiers also most probably. It is very active, but the effects of aconite are so well known that I need not linger over them here.

We come lastly to the different species of *Strychnos*, which are so largely used in South America, in the East Indian Archipelago, and to a much more limited extent in Africa for preparing those poisons. The most famous of them is the *Curare*, first brought to Europe in 1595 by Sir Walter Raleigh. Under various names it is used over the immense track of country comprised in the basins of the Amazon and Orinoco and their tributaries. A very minute and interesting account of its manufacture has been given by Humboldt, from which it appears that it is a concentrated extract made with cold water from the bark of several species of *Strychnos*, and that this is mixed with other poisonous and non-poisonous ingredients to increase its efficacy and consistence. It is not poisonous when swallowed, owing, it is said, to the slow rate at which it is absorbed, and Humboldt says that the Indians lick it off their fingers and use it as a stomachic tonic. Its harmlessness when given by the mouth has been frequently confirmed by exact experiment. But when injected subcutaneously it proves rapidly fatal by paralysing the ends of the motor nerves in muscle, so that movement becomes impossible and death takes place from the respiratory muscles ceasing to act on the chest wall. A large dose kills in a few minutes, and there is no antidote known. Besides this action on the nerves, which is due to curarin, it has a paralysing effect on the heart, due to a second active principle, discovered by Boehm and named by him curin.

In the Malayan Archipelago the *Strychnos* or *Upas tieute* furnishes a sap largely used for poisoning arrows, and the active principles being strychnine and brucine, we get the well-known convulsant effect of these substances in animals or men struck by the arrows.

I have, however, examined the root bark of two species of *Strychnos* used as an arrow poison by the natives of Perak in the Straits Settlements, and found that both had a marked digitalis-like action on the heart, as well as a curare-like action on the motor nerves (*Lab. Rep. Roy. Coll. Phys. Ed.*, vol. vi.). These are mixed with a third substance called "prual," which paralyses the muscles. When these different ingredients are mixed they form a most efficient means of dealing death, seeing that they paralyse simultaneously the heart, the motor nerves, and the voluntary muscles.

In conclusion, I may just mention two other poisons, neither of which is perhaps thoroughly authenticated. The Ainos in Japan are said to use a preparation made from aconite and tobacco, while the natives of the New Hebrides are stated to smear their arrows and spears with damp earth containing the tetanus bacillus, so that a cut infects their victim with this disease. It is more probable, perhaps, that the wound inflicted by these weapons sometimes become infected with the bacilli through the ordinary channels. The North American Indians do not use arrow poisons, nor do the aborigines of Australia, so far as is known.

In spite of the large number of arrow poisons which are known to us, the toxic actions are not very numerous, and can be roughly classed under five headings (although this does not include all, especially locally irritating substances): (1) Those which act on the heart and muscles, like digitalis ; (2) those which act on the nerve-endings, like curare; (3) those which act on the nervous system and heart, like aconite ; (4) those which act on the spinal cord, like strychnine ; and (5) those which have an action something like snake-poison.

On an antidote to these poisons the following paragraph appears in the *Pharm Jour.* for 1897, p. 458:—" The attention of the Government has recently been directed to the subject of arrow poison by the fatal results following the wounds caused by poisoned arrows in Uganda, and specimens of the arrows with the poison on them have, it appears, been sent by the Marquess of Salisbury to the Royal College of Physicians for investigation, in the hope that some antidote might be devised. The chief poison used in this part of Central Africa is evidently an *Acokanthera* (see *Pharm. Jour.* [3], vol. xxiv., p. 41), and an antidote to its action would in all probability prove an antidote to the poison of the arrows. Thanks to the researches of Professor T. R. Fraser, of Edinburgh, we are now in possession of a knowledge of the physiological action of the plant, and it should not be difficult to find a physiological antidote. Meanwhile, however, news has arrived from Uganda that Dr. Macpherson, who was with the Grant Column on the way to the Man Mountains, west of the Uganda Road, has discovered that the injection of a solution of strychnine answers the purpose of an antidote. He was able to bring round to life men wounded with the poisoned arrows, where previously the wounds had generally proved fatal. Should the investigations made by the College of Physicians prove that Dr. Macpherson's remedy is entirely successful, the fact will probably prove useful in two ways, for another antidote to strychnine poisoning will have been added to those already known, if, as may be presumed, the drugs should be mutually antidotal. Other African arrow poisons contain *Strophanthus*, and as strophanthin belongs also to the class of cardiac poisons and to the same natural order, it would be important to determine whether strychnine is also antidotal to *Strophanthus*." Those who are interested in the subject are referred to *Brieger Deut. Med. Woch.*, January 18th, 1900, September 28th, 1900, and March 31st, 1902.

POISONING BY ARTEMISIA (Sp. Var.). OIL OF WORMWOOD. ABSINTHE.

Source and Method of Occurrence.—A liqueur called ABSINTHE owes its properties to the presence of the oil of wormwood, with a large proportion of alcohol. It has been much used in France, and its effects when taken in excess are those of a narcotic poison. According to Legrand it causes derangement of the digestive organs, intense thirst, restlessness, giddiness, tingling in the ears, and illusions of sight and hearing. These symptoms are followed by tremblings in the arms, hands, and legs, numbness in the limbs, loss of muscular power, delirium, loss of intellect, general paralysis, and death.

Magnan, who had under his observation two hundred and fifty patients more or less injured in health by the abuse of this intoxicating liquid, and who has besides performed numerous experiments on animals, states that epileptic convulsions are generally observed in these cases. *Delirium tremens* is the ordinary result of the abuse of alcohol, but the epileptic attacks are specially referable to the absinthe. Magnan describes it as "absinthe epilepsy" (Husemann's *Jahresbericht*, 1872, p. 499, and Bouchardat's "Ann. de Thérap.," 1872, p. 66).

The following is the report of a case of poisoning by this oil. A druggist's shopman was found early one morning by his master, lying on the floor of the shop, perfectly insensible, convulsed, and foaming at the mouth. He was in a short time no longer violently convulsed, but was still insensible; the jaws were clenched, and the pupils dilated. The pulse was weak, compressible, and slow. From time to time he uttered incoherent expressions, and attempted to vomit. Repeated doses of stimulants, sal volatile and water, lime water, and an emetic of mustard and sulphate of zinc were administered. Free vomiting ensued, and consciousness partially returned. Artificial warmth was applied to the limbs, and brandy given at intervals, with draughts of milk and lime water. He gradually recovered. The matters vomited smelt strongly of oil of wormwood, and the nature of the poison was placed beyond doubt by the discovery of the bottle, with marks on its mouth of the oil having been recently poured out. The druggist stated that at least half an ounce had been taken. From the persistent smell of the oil in the ejected matters, after repeated vomiting, it is probable that this was even less than the real quantity. The man, on recovering had totally forgotten all the circumstances connected with the case, and persisted in stating that he knew no reason why he should have taken it. It is, however, probable that he imagined himself suffering from worms, and sought relief in an unusual dose of this oil (see "Ann. d'Hyg.," 1863, 1, p. 227).

Analysis.— Absinthe has a greenish colour, an aromatic odour like that of aniseed, and a hot pungent bitter taste. It acquires a milky appearance on the addition of water, owing to the separation of essential oil from the alcohol. It is a strong alcoholic mixture of oil of aniseed, oil of wormwood (of which it contains 0·02 to 0·04 per cent.), and other aromatic substances.

POISONING BY ARTEMISIA MARITIMA.

Source and Method of Occurrence.— The dried unexpanded heads of this plant, which is not uncommon on the coasts of the British Islands, form santonica, or wormseed, from which a glucoside known as santonin is obtained; it is much used as a vermifuge, and cases of poisoning from idiosyncrasy and overdoses are known. Santonica contains from 2 to 2½ per cent. of santonin.

Santonin has been occasionally mixed with and mistaken for strychnia or *vice versâ*.

Toxicity and Fatal Dose.—The toxicity of santonin must be reckoned as rather high, for about two grains of it have proved fatal to a child, aged five and a half years, in twelve hours. Recovery, in a child, has, however, followed after taking ten grains. Recovery has taken place, in a man, after taking an ounce of santonin in mistake for Epsom salts.

The official dose is for an adult two to five grains, and for a child a year old one-half to one-third of a grain.

Symptoms.—(i.) The special symptom is a peculiar disturbance of vision, objects appearing at first blue, then yellow; finally colour-blindness results for some time. This curious fact is explained by Hufner and Helmholtz as being due to the action of the santonin on the violet-seeing elements of the retina, which are first excited, producing the blue vision, and then paralysed, producing the yellow vision. (ii.) Headache, giddiness, and a species of intoxication frequently occur. (iii.) Gastric pain, vomiting, and laboured respiration may be produced. (iv.) In large doses convulsions, stupor, loss of consciousness, and death from collapse occur. (v.) The urinary secretion is increased, and the urine is coloured saffron-yellow (Luff).

Treatment.—The stomach should be emptied and washed out by means of the stomach-pump or stomach-tube; if neither of these be procurable, an emetic of mustard and water should be given. Stimulants should be administered to counteract the depressing action of the poison, and if convulsions are present, they should be treated with potassium bromide and chloral (Luff).

Post-mortem Appearances.—Nothing characteristic.

Analysis.—Santonin may be extracted from *acid* aqueous solutions by shaking out with chloroform; it will not come away from alkaline solutions, as it plays the part of a weak acid, forming combinations with alkalies which are soluble in water.

A solution of sodium hydrate produces a violet-red colour with santonin. Dragendorff has devised a modification of a former test which is thus performed:—A little sulphuric acid diluted with half its volume of water is added to some santonin, and gently heated until a yellow colour is produced; when cold a few drops of a very dilute solution of ferric chloride are added, and on again warming a blue or reddish-violet colour is produced (Mann).

Luff thus describes the sulphuric acid test:—

Strong sulphuric acid is diluted with half its bulk of water, a little of the diluted acid is added to some santonin in a porcelain dish, and the mixture warmed on a water-bath until a yellow colour is developed; while warm a few drops of dilute solution of ferric chloride are added drop by drop; as each drop falls in, a ring of a beautiful red or reddish-violet colour is produced around each drop, changing to purple, and afterwards to brown.

The presence of santonin in the urine may usually be ascertained by the addition of a little sodium hydrate; if present a red colour is produced. Rhubarb present in the urine yields the same reaction; but if, after the addition of sodium hydrate, excess of milk of lime is added, and the urine afterwards filtered, the filtrate is colourless if the reddening is due to rhubarb, but retains its colour if it is due to santonin.

It crystallises in four-sided tables, which have the remarkable property of acquiring a brilliant yellow colour by exposure to light (*photosantonin*). It is not soluble in cold water, and has no taste; but it is soluble in alcohol, and the solution has a bitter taste. Its best solvent is chloroform, four and a half parts of which dissolve one part. It melts at a high temperature, and sublimes in white crystals a few degrees above its melting point. Nitric, iodic, and sulphuric acids have no action on it. Sulphomolybdic acid produces a pale reddish-brown colour. Bichromate of potash added to the mixture with sulphuric acid produces no colours like strychnia, but only green oxide of chromium.

Cases.—A man gave to his daughter, æt. 10, about 155 grains of wormseed for the cure of worms. In two or three hours she was seized with violent vomiting, followed by convulsions, with coldness of skin. The following day worms were discharged. She was seen by Dr. Linstow on the third day. There was severe vomiting, with convulsions, the pupils were dilated and insensible to light. The girl was drowsy, and suffered from some pain in the stomach. She died before any medicines could be employed. The body was not inspected (*Vierteljahrsschr.*, 1874, vol. 3, p. 81).

Mann records the following curious case of chronic poisoning by santonin:—

A boy, aged eleven years, who, on account of pain in the abdomen, which was supposed by his mother to be due to worms, had santonin given to him for months. Clonic spasms then developed, to combat which the doses of santonin were increased. Paralysis, twitchings, dizziness, pain in the head, vomiting, yellow and violet vision, sparks before the eyes, and finally loss of speech occurred and necessitated medical advice. Under treatment the patient was able to walk in six weeks, but it was nine weeks before he regained the power of speech.

POISONING BY ARUM MACULATUM.

Source and Method of Occurrence.—This plant is a common British plant, putting up its leaves and spathe in early spring. It is popularly known as "lords and ladies," and children occasionally suffer from chewing parts of the plant. The editor is informed that during the potato famine in Ireland large quantities of the big bulbous root of the plant were dug up and eaten. When eaten raw they produced toxic symptoms, but after boiling they appeared to be innocuous. The following, with the exception of the doubtful case given under Solanum nigrum, is the only case the editor can refer to:

An inquest was held at Combe St. Nicholas, near Chard, on April 7th, upon the body of a girl, aged three years, who had died suddenly after having eaten some plants in the garden. A post-mortem examination showed that death was due to poisoning with the leaves of the arum maculatum, and a verdict of death from accidental poisoning was returned (*Lancet*, 1, 1900, p. 1176).

POISONING BY ASPIDIUM FILIX-MAS, OR OIL OF MALE FERN.

Source and Method of Occurrence.—The official preparation extr. filicis liquidum, dose 45 to 90 minims, is obtained from the rhizome of the ordinary male fern aspidium filix-mas. The fern is a common one in England. Cases of poisoning by it are rare, but even fatal ones are recorded (*infra*).

Toxicity and Fatal Dose.—The medicament depends for its active properties on the presence in it of acidum filicinum, which is not official, but the dose in the Extra Pharmacopœia is given as six to fifteen grains. It cannot therefore be considered as a very virulent poison.

The case recorded by Freyer (*infra*) has a practical bearing. The toxic properties of the extract of male fern are augmented by the presence of additional oil to that contained in the extract itself; the same child tolerated twice as much of the extract alone as that which proved fatal when given in combination with castor-oil. It is advisable, therefore, not only to avoid giving a mixture of the extract with castor-oil, but also to give some other laxative than oil, if one is subsequently needed. A case is recorded by Schlier in which an adult very nearly lost her life, probably owing to a tablespoonful of castor-oil being given one hour after a draught which consisted of extract of male fern mixed with the powdered root.

Treatment.—If spontaneous vomiting does not occur, the stomach should be emptied either by the tube or an emetic, after which general treatment will be required, and probably the administration of stimulants (Mann).

Case.—The editor is indebted to Dr. C. F. Wakefield for the following case. It occurred in 1898.

A man, æt. 25, at 10.30 a.m., took eight ten-minim capsules of oil of male fern; at 11.30, Epsom salts, one ounce, at once; 3—5 p.m., attended his cows; 8—10 p.m., at the inn, where he drank two pints of beer only. He had no food all day: he walked home, half a mile, shut up his chickens and poultry for the night and talked to his wife quite rationally. He then, about 10.30, stooped down to take off his boots, and was sick two or three times, vomiting "half a pailful." Bowels had been open six times during day. 10.30—12.30, he was quite unconscious; before becoming so five men held him down to prevent him biting. I washed him out, but only got away a lot of glairy mucus. He came round about 1 a.m. Pulse 140; feet cold. He had previously taken eighteen five-minim capsules, followed by castor-oil immediately. "It all went through in half an hour." The chemist sold the box of three dozen capsules without any directions or advice.

The following cases are related by Mann ("For. Med.," p. 570):—

A man, thirty years old, was given a draught containing one ounce and a half instead of one drachm and a half of the extract of male fern, which he took in two doses. Soon after the first dose he felt unwell, and after the second, which was given some hours subsequently, he began to vomit, and was purged; then followed cramps, profuse sweating, delirium and coma, which ended in death about twenty hours after the draught was taken. At the necropsy the omentum and the peritoneal covering of the small intestines were bright red, and in the sub-mucous tissue of the stomach were ecchymoses with linear extravasations on the surface of the mucous membrane. An instructive case is related by Freyer, in which a child, aged two and three-quarters, took eight capsules—each containing about fifteen grains of extract of male fern, along with the same quantity of castor-oil—in five hours; she became somnolent and as though paralysed, and died after the occurrence of some spasms. Section showed petechial ecchymoses in the mucous membrane of the stomach, pronounced injection of the mucous membrane of the intestines and venous filling of the various organs. The interesting point to note is that three weeks previously the child took double the quantity of the extract, *but without the castor-oil.* A case is recorded by Hofmann, in which a child, five and a half years old, had very nearly two drachms of the extract given to her in three draughts; death took place in six hours, with symptoms of trismus and general spasms. The same appearances were found as in the other cases.

POISONING BY ATRACTYLIS GUMMIFERA.

Source and Method of Occurrence.—This plant seems to be a native of the Mediterranean district. It grows freely in our possession of Malta. The following case is reported by Dr. Zammit, from the Public Health Laboratory, Malta, in the *B. M. J.*, 1, 1898, p. 211.

The carline thistle (local name, Xeckit-il-Miskta) is the *Carlina gummifera* (Dec.), *Atractylis gummifera* (Lin.), a plant common in Malta and in other countries on the shores of the Mediterranean. It is notable for its root, which can grow to enormous proportions, and for its purple composite flower surrounded by spinous leaves.

Three children ate the root of one of these plants, which they cut with a knife; two of them, a girl aged eight years and a boy aged nine, eating it rather freely. They ate it on a Wednesday afternoon, and did not complain at all before the catastrophe came on. On Thursday evening the girl was taken ill, and the parents were soon alarmed at the stertorous breathing and at the drowsiness of the child. There was some retching, but no actual vomiting. Early in the morning the child became collapsed and died before any medical aid could be got. In the evening of Friday the boy returned home and refused to eat. He was told that the girl had died, and he confessed that they had been eating some roots the day before. He went to bed, and soon after the family were startled at his difficult breathing. The father of the girl (the children were cousins) was sent for, and he declared that his daughter had suffered in the same way. The district medical officer was hastily called, but it was too late, as the boy died a few hours after, comatose and with marked signs of asphyxia.

At the post-mortem examination the two bodies had the same appearance. The tongue protruded slightly between the lips; the pupils were greatly dilated. The appearance consisted in a general congestion of the venous system. In the girl all the organs were highly congested, the lungs and the brain especially so. The stomach showed capillary injection in limited areas. It contained a brown liquid in which fibres of the ingested root were identified. The intestines were congested and contained abundant solid fæces. The heart in both cases was flaccid, and contained a little dark fluid blood.

In the boy the congestion was not so well marked in the organs, with the exception of the brain, of which the veins were injected to the extreme. No trace of the root could be found in the stomach, but the fibres were found abundantly in the intestines, which contained a very great quantity of solid fæces. No attempt was made to examine chemically the organs, as the poisonous principle of the plant is not known to me. I have searched all the books of botany and medical jurisprudence which I could find here, but no cases of poisoning by this plant are fully described, nor is the active principle of the plant mentioned anywhere. The only literature on the subject I am aware of is an article in the *Barth*, September, 1875, an extinct local medical paper, which refers to a communication by Lefranc in 1866 to the Botanic Society of France. No definite notions on the active principle of the plant can be gathered from that article, and I could not obtain the *Bulletin* of the Botanic Society of France.

The third child, a boy of about twelve years of age, ate a small quantity of the root. Up to Saturday morning he did not complain of the least ailment, but he was given a good dose of castor-oil, which he very much needed, and is well.

POISONING BY ATROPA BELLADONNA.

Source and Method of Occurrence.—All parts of this plant, *Atropa belladonna* (also known as deadly nightshade), are poisonous. The plant is luckily rather rare in England, for its fruit very closely resembles a nice black cherry, and accidents from children eating the fruit are known. Several deaths from the poisonous effects of the fruit occurred in London in 1846.

The *root* of the belladonna, administered in the form of decoction as an enema, has destroyed life.

Eighty grains of the root were employed, and the liquid, strained and reduced by evaporation to four ounces, was injected. After a slight stage of excitement, the patient, a female, æt. 27, fell into a state of complete coma; the countenance appeared swollen, and of a reddish-brown colour; the pupils were excessively dilated; the pulse was at first full and hard, then small: death took place in five hours (Casper's *Wochenschr.*, February 8th, 1845, p. 101).

According to Schmidt and Schutte the root contains from $\frac{1}{8}$ to $\frac{1}{2}$ per cent. of alkaloid.

The *leaves* of belladonna have occasionally given rise to accidents. They have been ignorantly supplied for ash-leaves, and half a wineglassful of the decoction of the leaves produced on Garrod the usual symptoms of poisoning by this plant. His patient, who took half a pint, suffered severely. The leaves of belladonna are peculiar in shape.

The official preparations of belladonna are: Succus, dose 5 to 15 minims; tincture, dose 5 to 15 minims; three extracts, viz., the alcoholic, dose $\frac{1}{4}$ to 1 grain, the liquid (standardised to contain ·75 gram. in 100 cc.) used to prepare the alcoholic, and the green, dose $\frac{1}{4}$ to 1 grain, and linimentum, from each of which accidents have arisen.

Atropine.—Atropine, or atropia, is the name given to the alkaloid extracted from belladonna, and to which the poisonous effects are due. This alkaloid is a powerful poison. It exists in the plant chiefly as hyoscyamine, which, during the process of extraction, is converted into atropine (*vide* "Extra Pharm.," 1904, p. 103). Physiologically, the alkaloids are identical. An ointment, lamellæ, each containing $\frac{1}{5000}$ grain, for eye work, and a liquor, dose 1 to 8 minims, are the official preparations of the alkaloid.

Cases of atropine poisoning of a mild character are common in hospital practice, in consequence of idiosyncrasy to the drug.

The criminal administration of atropine is a rare event in this country. A trial for murder by this alkaloid took place at the Manchester Lent Assizes, 1872 (*R.* v. *Steele*).

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The prisoner, who was a nurse in the workhouse, was charged with administering atropine to the senior surgeon, and thereby causing his death. The deceased was taken suddenly ill after his breakfast, and died under the usual symptoms of poisoning with atropine in about twelve hours.

The poison was detected in the body, and also in a liquid found in the room—a solution of atropine in spirit. Milk was the vehicle through which it was taken. The milk as sent from the kitchen contained nothing injurious, but that found in deceased's room was tasted by two of the nurses, and both suffered from poisoning by atropine. The prisoner had access to this room, and it was alleged that she had a strong motive for this criminal act, but there was no direct proof to show that she put the poison in the milk, and she was acquitted.

In 1891, six deaths were recorded in England and Wales from belladonna and its preparations; and ten in 1901, of which four were suicidal, the remainder accidental.

Toxicity and Fatal Dose.—The active principle (atropine) to which all the preparations owe their toxic effects is extremely poisonous, the official dose being only from $\frac{1}{200}$th to $\frac{1}{100}$th of a grain.

In 1850, Sells, of Guildford, forwarded to the author for examination the stomach of a young man who had poisoned himself by taking *two grains* of atropine. He took the dose on going to bed. He was heard to snore heavily during the night, and was found dead about seven o'clock in the morning, lying on his right side, the surface livid, the limbs rigid and contracted, and with a little brown matter issuing from the mouth. The pupils were much dilated. The mucous membrane of the stomach presented a diffused redness, which might have arisen from some brandy which he had swallowed. No trace of the poison could be detected in the stomach nor in its contents.

A woman, æt. 66, swallowed a teaspoonful of belladonna liniment, and, after suffering the usual symptoms, died in sixteen hours. This is the smallest recorded fatal dose of the liniment.

Recovery is recorded (*Lancet*, 1891), from half an ounce of the extract. **Half a grain** of atropine has proved fatal. In the cases (*infra*) is one recorded of recovery from a grain of atropine after treatment with morphia.

Duration.—The symptoms come on within an hour or so, dependent in this respect somewhat on the method of administration, and death occurs in a few hours. In the *B. M. J.*, 1878, a case of death on the *sixth* day is recorded.

Symptoms.—In all cases of poisoning by belladonna the symptoms are very uniform, the following are old but absolutely typical cases:—

A boy, æt. 14, ate, soon after breakfast, about thirty belladonna berries, which he had bought as fruit in the streets. In about three hours he had the sensation of his face being swollen; his throat became hot and dry, his vision was impaired, objects appeared double, and they seemed to revolve and run backwards. His hands and face were flushed, and the eyelids swollen; there were occasional flashes of light before his eyes. He tried to eat, but could not swallow on account of the state of his throat. In endeavouring to walk home he stumbled and staggered; and he felt giddy whenever he attempted to raise his head. His parents thought him intoxicated; he was incoherent,—frequently counted his money, and did not know the silver from the copper coins. His eyes had a fixed, brilliant, and dazzling gaze; he could neither hear nor speak plainly, and there was great thirst; he caught at imaginary objects in the air, and seemed to have lost all knowledge of distance. His fingers were in constant motion: there was headache, but neither vomiting nor purging. He did not reach the hospital until nine hours had elapsed, and the symptoms were then much the same as those above described. He attempted to get out of bed with a reeling, drunken motion: his speech was thick and indistinct. The pupils were so strongly dilated that there was merely a ring of iris to be seen, and the eyes were quite insensible to light. The eyelids did not close when the hand was passed suddenly before them. He had apparently lost the power of vision, although he stared fixedly at objects as if he saw them. The nerves of common sensation were unaffected. When placed on his legs he could not stand. His pulse was ninety, feeble and compressible; his mouth was in constant motion, as if eating. On admission his bladder was full of urine. He continued in this state for two days, being occasionally conscious, when by a free evacuation of the bowels, some small seeds were passed: these were examined and identified as the seeds of belladonna. The boy gradually recovered, and left the hospital on the sixth day after his admission: the progress of recovery was indicated by the state of the pupils, which had then only acquired their natural size and power of contraction. In three other cases which occurred at the same time, the berries having been baked in a pie, pains in the limbs, drowsiness, insensibility, and convulsions, were among the symptoms. In two instances of poisoning by the berries, the symptoms bore some resemblance to those of delirium tremens. The symptoms are sometimes delayed.

In September, 1892, a boy, aged five years, died at Mortlake from eating belladonna berries. In this case the symptoms did not appear till the morning after the berries were supposed to have been eaten, and he lived sixteen hours after the appearance of symptoms of atropine poisoning. There was no delirium; there was thirst, flushing of the face, and the heart's beats were audible at a distance of several feet. Unconsciousness quickly supervened. The seeds of the plant were found in the intestines after death, and Mackintosh detected atropine both in the stomach contents and in the urine.

Two persons swallowed a small spoonful of the *extract* of belladonna by mistake for that of juniper. There was speedily indistinctness of vision, tottering gait, delirium, incoherency, hallucinations, and dilatation of the pupils. In one there was great cerebral excitement. Under treatment, the symptoms of poisoning disappeared in two days; but one of the patients died on the seventh day from disease. The physical and physiological properties of the extract indicated that it was belladonna; but the attempt to procure atropine from it entirely failed. A portion of the concentrated extract given to a dog, caused dilatation of the pupil in a quarter of an hour. In a case of compound poisoning by extract of belladonna and tincture of opium, there was the violent excitement produced by belladonna, but the pupils were strongly contracted as in poisoning by opium (*Med. Times and Gaz.*, 1870, 1, 564). A lady suffered from severe symptoms of poisoning, and nearly lost her life, owing to an injection, containing one drachm of the extract of belladonna and one drachm of wine of opium, having been administered to her. The pupils in this case were dilated, and the opium apparently did not counteract the effects of the belladonna.

Treatment.—The following is taken from Luff (" For. Med.," p. 294). It is in accord with the best modern experience:—" The stomach should be emptied and thoroughly washed out by means of the stomach-pump or stomach-tube, or, if neither of these be procurable, an emetic of mustard and water should be given. The best and most rapidly acting antidote to atropine is pilocarpine. One-third to one-half of a grain of the nitrate of pilocarpine should be hypodermically injected, and the injection, if necessary, should be repeated an hour later, the indications for this repetition being the continued dilatation of the pupils and dryness of the skin. The beneficial action of pilocarpine is indicated by commencing contraction of the pupils, sweating, and abatement of the delirium and other symptoms. Stimulants and hot coffee should be administered. In the collapse stage artificial respiration may be found necessary. The administration of morphine hypodermically in cases of poisoning with belladonna or atropine has been frequently recommended, and certainly the tolerance of morphine exhibited in atropine poisoning is striking, and is in favour of the antagonism of these drugs; but, although atropine may be of use in cases of opium or morphine poisoning, the converse is not by any means so certain. If pilocarpine be not at hand, hypodermic injections of morphine may be employed in cases of belladonna or atropine poisoning, but it should only be used in the stage of excitement, and not in the final stage of collapse, when its use would be dangerous. An interesting example of the good effects of pilocarpine is related (by Campbell), in which a male, aged sixty, had administered to him by mistake a tablespoonful of a liniment consisting of equal parts of belladonna liniment and tincture of opium. Although the so-called physiological antidote, morphine, was present in this liniment, the typical symptoms of belladonna poisoning supervened. Recovery took place after hypodermic injections of pilocarpine, which were repeated until one grain of pilocarpine in all was injected; the patient lapsed into a comatose condition during an interval of about six hours, whilst a fresh supply of pilocarpine was being obtained."

The Edinburgh Committee, presided over by Dr. Hughes Bennett, conclude: (1) that sulphate of atropia is, within a limited range, physiologically antagonistic to meconate of morphia; (2) that meconate of morphia does not act antidotally after a large dose of atropia, and thus while atropia is an antidote to morphia, morphia is not an antidote to atropia. Physostigmine, in relation to atropine, is considered to have a wider range of antidotal action than morphia. Although it is experimentally proved that atropine can avert death from physostigmine the question yet remains unsolved whether physostigmine can prevent death from atropine.

Under "Cases" is noted an instance where one-half grain of morphia probably saved the life of a boy of five years of age.

Post-mortem Appearances.—Unless portions of the plant are found in the stomach, there is nothing found even suggestive. The old congestions, etc., which used to be so minutely described are simply due to hypostasis or to cardio-respiratory failure, common to many deaths other than poisoning. The pupils have been found dilated thirty-four hours after death (*Lancet*, 1870, 2, p. 83), which might be suggestive.

In some instances the mucous membrane has been dyed by the juice of the berries.

A boy, æt. 5, after having eaten a quantity of belladonna berries, went to bed, was very restless, vomited once, and died in convulsions about fifteen hours after having taken the poison. On inspection, in the stomach there was some fluid, with three open berries; the mucous membrane was of a reddish-blue colour in various parts (Canstatt's *Jahresber.*, 1844, v.).

Analysis.—The indigestible nature of the leaves, fruit, and seeds will commonly lead to their detection in the matters vomited or passed by the bowels, or in the contents of the viscera after death. The seeds of belladonna are very small—they can, however, be distinguished by the microscope from the seeds of other poisonous plants. The *seeds* of belladonna are small, of a somewhat oval shape, and of a dark colour. Under a low magnifying power they have a honeycombed surface. In henbane the surface of the seeds presents more irregular depressions, resembling those seen on certain corals or madrepores. The colouring matter of the berry is of a deep purple hue. The leaves are known by their botanical characters and a decoction or infusion of them, by the liquid causing dilatation of the pupil. Atropine is one of the three natural pupil-dilating alkaloids. It occurs not only in belladonna, but also in stramonium. The urine, blood, or other organic liquid containing this poison, applied to the eye of an animal, causes dilatation of the pupils. This may be employed as a physiological test for detecting the presence of atropine in an extract made from the contents of the stomach, or of any organic liquid.

Atropine is a white crystalline substance, not very soluble in water but easily dissolved by alcohol, ether, and diluted acids. It does not readily crystallise, but it forms crystallisable salts. Ammonia added to the solution of sulphate of atropine does not separate the alkaloid in distinct crystals. In this respect it differs from morphine and strychnine. When atropine is heated on platinum it melts, darkens in colour, and burns with a yellowish smoky flame. Sulphuric, hydrochloric, and nitric acids dissolve it without any change of colour. Water added to the mixture of sulphuric acid produces no change: but a crystal of bichromate of potassium produces a green colour. Tannic acid precipitates the alkaloid from its solutions: but the most effectual precipitant is potassio-mercuric iodide, which throws down a dense white precipitate even in very diluted solutions. Atropine is also precipitated by auric chloride, but, unlike strychnine, it is not precipitated by sulphocyanide of potassium nor by chromate of potassium. When a fragment of the alkaloid is moistened with fuming nitric acid, evaporated to dryness, and the residue moistened with alcoholic solution of soda, a fine purple colour is produced. This is known as Vitali's test. It may be separated from organic liquids by the process on p. 352. According to Winckler atropine is precipitated most completely from all its solutions by potassio-mercuric iodide. A crystal of atropine dissolved in alcohol yields when warmed with solution of corrosive sublimate a yellow precipitate, which soon turns reddish. By the use of this precipitant the proportion of atropine contained in the powder of the dry leaves and root can be determined.

In the leaves the alkaloid varies from 0·41 to 0·49 per cent., and in the root it amounts to 0·48 per cent. (*Pharm. Jour.*, June, 1872, p. 1029).

Cases.—In the *Pharm. Jour.*, 1898, p. 499, a case of fatal poisoning by atropine is reported, in which a medical man gave himself a hypodermic of atropine in mistake for morphia. He was accustomed to taking morphia, and, therefore, gave himself a larger dose (by hypodermic tabloid) than he would otherwise have done. The tabloids of morphia, and of atropine, were similar in appearance, and kept in similar bottles, hence the mistake made by the chemist.

The following from the *Lancet*, 1, 1901, p. 1198, well illustrates the typical symptoms of poisoning by atropine. It also bears witness to the happy effects of the boldness of the medical man in giving half a grain of morphia to a child.

At 2.30 on the morning of March 7th, 1901, I was called to attend a boy, aged five years, alleged to have been accidentally poisoned by his mother. The parents' account was as follows: At 9.30 p.m. the mother gave the child a large tablespoonful of what she took to be syrup of senna. She then left home to nurse a sick relative, and did not return till shortly before 2.30 a.m. About midnight, the father, who slept with the boy, observed him to be breathing rapidly, and was particularly alarmed at the loudness of the heart-sounds. He got up and took the boy out of bed, and was still more alarmed to find that the child could not stand. Having been thus aroused, the child became violently delirious, striking out with his fists, kicking, and biting on the slightest interference with his person. On being put back to bed, he could scarcely be kept under the blankets on account of the violence of his movements. The father did his best to keep the boy quiet until the mother's return. When she saw the state of matters her suspicion of poisoning was aroused, and on examining the bottle from which she had given the dose, she found it to be labelled "Poison." She, therefore, immediately sent for medical aid. When I arrived, I found the boy in the state described above. When left alone in bed, he came out from under the blankets, and wandered on hands and knees aimlessly about the bed, occasionally crying out. The delirium and violent movements were increased when efforts were made to control them. The movements were at no time convulsive. The face was flushed, not cyanosed. The pupils were widely dilated, and failed to respond to light. The pulse and respiration were strong and rapid, and the heart sounds were very loud. The boy was unable to speak. I found the suspected bottle to contain glycerine of belladonna. I ascertained that the boy had not vomited. As the evidences of belladonna poisoning were undoubted, I washed out the stomach with the syphon. A good deal of the water first introduced was vomited over the child's nightshirt, which was of a dark brown colour, so that it was difficult to tell from its appearance whether it contained belladonna extract or not. That which came through the syphon was clear. There was no odour of belladonna from the washings. Considering that five hours had elapsed since the poison was taken, I deemed it highly improbable that any of it still remained in the stomach.

After completing the washing of the stomach, I gave a hypodermic injection of a quarter of a grain of morphia sulphate, and a tablespoonful of castor-oil, by the mouth, which was swallowed. In a short time the boy became quiet, and I left the house, having directed the parents to send for me should any further alarming symptoms arise.

I was unable to see the patient again until 11 a.m. Then I ascertained that he had slept well till ten, and on awaking still exhibited symptoms of the same kind, but less aggravated. The delirium now was of a hilarious character, somewhat resembling drunkenness. The child laughed and chatted about his school experiences, games, fights, etc. The bowels had not yet moved. I then gave another hypodermic injection of one quarter of a grain of morphia sulphate and three grains of calomel by the mouth. The boy did not again sleep till about eleven o'clock. During the whole of that day somebody had to remain constantly at the bedside to keep him in bed. Several times he attempted to bite those trying to control his movements. Although the mouth was very dry, and the tongue was constantly rolled about, the boy refused food or drink, and spat out whatever was introduced into his mouth. At two in the afternoon, the bowels not having yet moved, the mother gave a small soap-and-water enema, after which there were three or four liquid motions. The boy continued in the same mental state till about 11 p.m., when he fell asleep. Shortly after 11 p.m. I visited the patient, and finding him sleeping tranquilly, I judged it best to do nothing. He had a good night's rest. The following morning at ten I found him awake, and presenting no abnormal symptoms, except dilatation of the pupils, which persisted for four days. No rash at any time appeared upon the body, and there was no peeling of the skin. After recovery the boy seemed to have no recollection of the incidents which occurred during his illness.

For other cases of poisoning, *vide B. M. J.*, 2, 1899, p. 1792, where its application to a woman's breast caused toxic symptoms. Also *B. M. J.*, 1, 1904, p. 189, where symptoms arose with the tenth drop in the eye of an atropine solution, strength one grain in two drachms. Also *B. M. J.*, 1, 1897, p. 1157, a case of recovery after three grains of atropine on treatment with morphia.

The following case, which occurred in 1871, is remarkable for the fact that the victim recovered from a large dose of the extract.

A nurse gave by mistake to a lady whom she was attending a belladonna liniment containing three drachms of the extract, mixed with soap liniment. She vomited slightly, and suffered from dryness of the throat, difficulty of swallowing, drowsiness, delirium, dilated pupils, fixed stare of the eyes, loss of power, and difficulty of speech. Paralysis of the extremities came on, with great pain in the back. Emetics, with brandy and cayenne pepper, were employed with success. The woman recovered, but not until after five weeks from the time of swallowing the liniment.

In 1880, a boy, æt. 12, was admitted into Guy's Hospital who on the previous day had eaten some ripe belladonna berries whilst on a country excursion. On returning home he went to bed as usual, but awoke at 2 a.m. in much the same condition as on his admission at 5 a.m. He was then delirious, and in such violent convulsions that he was unable to sit still a moment. He talked most incoherently. He apparently could not swallow, as he put water into his mouth and spat it out again, the effort throwing him into severe convulsions. At 10 a.m., the delirium and convulsions still continued; there was a marked flushing on the legs and face, and the latter was somewhat swollen. The throat was red, and he showed aversion to water. The pupils were widely dilated. The delirium continued, with convulsions, all day and during the next night, though occasionally he spoke rationally. He was flushed, and appeared like a child in the early stage of a scarlatina rash. At noon—about forty-two hours after (as was supposed) the berries were eaten—one-third of a grain of a salt of morphine was injected hypodermically. The boy slept, and next day awoke well.

POISONING BY CANNABIS INDICA.

Source and Method of Occurrence.—The dried flowering or fruiting tops of the female plant, grown in India, are now official as the source of two pharmacopœial preparations—an extract, dose a quarter to one grain, and a tincture, dose five to fifteen minims. Preparations of the plant form the basis of the well-known bhang or haschish used very much in Eastern countries as a means of intoxication, and in those districts poisoning by the drug in both acute and chronic forms is by no means uncommon. In England poisoning by it is rare, and only occurs as the result of accidental overdoses.

Toxicity and Fatal Dose.—The active effects of the drug appear to be due to an oleo-resin (*B. M. J.*, 2, 1899, p. 1354). The fatal dose of the drug or its preparations is unknown, but doubtless habit has a good deal to do with it, as in the case of opium in countries where the drug is habitually used.

Duration.—In acute cases toxic symptoms appear within a quarter to half an hour of taking the substance, and death has supervened in twelve hours (Mann).

Symptoms.—These somewhat resemble those of opium, generally consisting at first of a pleasurable excitement of the mind; giddiness and sleepiness soon supervene, followed in fatal cases by coma and collapse. The following is a fairly typical case:—

The patient, a boy, æt. 12, took a dose of the medicine (ten minims of the tincture) and in a few minutes said he felt a burning pain in the pit of his stomach and soon became strange in his manner, saying that his legs were jumping about and that he heard a ticking like a watch, that he saw the room on fire and the pictures falling down, etc. On admission to the hospital he looked extremely ill, very pale, anxious, and distressed. He complained of no pain, but he was much collapsed. His pulse was 120, being scarcely perceptible at the wrist; the pupils were dilated, but acted sluggishly to light. He was at once laid on a couch, was covered with blankets, and was given two drachms of brandy in hot water, and immediately after this ten grains of citric acid in syrup of lemon. A blister was applied to the nape of the neck. He soon began to revive, his colour improved, and in about two and a half hours he had recovered and said that he felt quite well—his headache had gone and he was able to walk back to his home (*Lancet*, 2, 1896, 1078).

Or the following, from six grains of the extract:—

A few weeks ago I was called about 11 p.m. to see a young woman who had, it was alleged, "gone out of her mind." I thought at first I had to do with an ordinary hysterical fit, but closer observation convinced me that although the symptoms were a curious caricature of some hysterical attacks there were other symptoms that made such a diagnosis untenable. Fits of laughter and incoherent ravings alternated with comparatively lucid intervals. She complained of various hallucinations and delusions, chief of which were a complete perversion of the relations and lapse of time and a loss of identity. She was now herself, now again a different individual, and the modifications of her behaviour in relation to her dual personality were grotesque. I was entirely at a loss as regards the cause of the patient's condition until her mother volunteered that she had been taking Indian hemp. Like many other foolish people they had purchased a book on family medicine. The girl had suffered severely from headache for some time and after consulting the book they pitched upon Indian hemp as the likely remedy. A local chemist made them a dozen pills, each containing one-half grain of the extract. The girl took one with no relief, then two with a similar effect. She then concluded that they were "a fraud" and to demonstrate it swallowed the remaining nine with the result that I found her four hours after in the above-mentioned condition. I administered strong coffee and gave her a few doses of strychnine, and she quite recovered on the following day (Baxter-Tyrie, *Lancet*, 2, 1897, p. 1452).

Treatment.—The same as for opium (Mann).

Post-mortem Appearances.—Nothing in any way characteristic.

Cases.—The editor is unable to find a fatal case recorded. The two following are of interest from the smallness of the doses that caused the symptoms, seven minims, and twenty-four minims in two separate doses respectively:—

A lady, æt. 30, suffered from symptoms of poisoning, following a dose of only seven minims of the ordinary tincture. After taking this quantity in a mixture she became drowsy, her vision was dimmed, she was sick, had great thirst with dryness of the fauces, and slept heavily. Four hours after she had taken the tincture, she was still in a state of narcotism, very drowsy and not easily roused. The pupils were fully dilated, the eyes suffused, the tongue dry, and the pulse small and quick. The symptoms were followed by profuse perspiration. The next day the symptoms had disappeared with the exception of some dryness of the mouth and feverishness (*Lancet*, 2, 1871, 493).

In June, 1897, I saw a patient, aged thirty-three years, who complained much of an attack of migraine. I ordered her a mixture containing ten grains of strontium bromide and twelve minims of the tincture of Indian hemp in each dose, one to be taken every fourth hour till the pain was relieved or until four doses had been taken. After the first dose she felt much better and went out to make some purchases. On returning, about four hours after taking the first dose, she took a second dose; within a few minutes she felt a strange feeling and an inclination to jump down the stairs. This she knew was absurd, so she clung to the banister; she then went into her room and to bed, when I was sent for. I found her in bed in an excited, joyous state, quite conscious, but, as she said herself, unable to control herself; she talked incessantly and assured me that she had such a good story to tell me, etc. Her eyes were brilliant and the pupils were slightly dilated, but they reacted to light; her pulse was full and soft. She mentioned that she had a creeping sensation in her arms and legs. As it was more than an hour since she had swallowed the medicine and the symptoms were not urgent I did not administer an emetic, but gave her some strong black coffee, and assured her that she would be quite well in a short time. In about half an hour she became quiet, and she then slept for an hour, on awaking being quite herself (Roche, *Lancet*, 2, 1898, p. 1701).

Poisoning by Capsicum minimum (Cayenne Pepper).

A medical botanist was charged with having caused the death of a boy, æt. 15, by administering to him dangerous medicines (*R.* v. *Stevens*, C. C. C., May, 1864). The boy was suffering from diseased hip-joint, and, after taking the medicines prescribed by the prisoner, he died. Letheby examined the stomach, and found in it patches of inflammatory redness, such as would be produced by an irritant. He could detect no poison, but simply bilious matter mixed with cayenne pepper. The mixture prescribed by the prisoner contained this pepper, which the witness considered to be injurious to a person in the condition of deceased. The prisoner was acquitted, the connection of the death of deceased with his act not being proved.

In small quantities, this is a well-known stimulant and a useful condiment and medicine. It has a hot, fiery taste, which lasts for a long time. It is a powerful stimulant, and in large doses produces a feeling of heat in the throat, difficulty of swallowing, pain in the stomach, and inflammation of the gullet and stomach. Locally applied it causes redness and even blistering of the skin (Wibmer, "Arzneimittel," art. "Capsicum"). There is no undoubted instance recorded of its having proved fatal. It owes its irritant properties to an acrid resin (capsicin). From five to ten grains of the powder is considered to be a medicinal dose.

Guinea Pepper, known as grains of paradise, is popularly considered to be highly noxious; but there are no facts to justify this view. This kind of pepper is an aromatic condiment.

Poisoning by Chailletia toxicaria.

The following case, reported *B. M. J.*, 1904, p. 1314, by Dr. Renner, is inserted for corroboration by subsequent cases that may occur.

J., a Mendi labourer, aged about twenty-four years, was admitted on the morning of November 18th, 1903, at 10 a.m. He could not speak English fluently, and the following history was obtained from his friends.

On the morning of November 18th, 1903, some fish, on which had been sprinkled the powdered fruit of the ratsbane for the purpose of killing rats, having been given to him to throw away, he ate the largest portion of it. In about half an hour afterwards he had vomiting followed by looseness of the bowels and general trembling. On his admission into hospital about 10 a.m. he again vomited, and his condition then, as described by himself through an interpreter, was as follows: "He was feeling very weak and unable to walk, his legs were dead, he was losing power over his arm, and he was feeling very bad." On examination in the ward it was found that the patient was suffering from paralysis of the lower extremities. The tendon reflexes were abolished. There was marked hyperæsthesia of the inner side of the thigh and legs. Firm pressure of the muscles of the calves gave unusually severe pain. The action of the bladder and rectum remained undisturbed. Although the pupils were normal yet the patient's vision was not acute. There was some want of co-ordinating power in the muscles of the upper extremities. The power of deglutition was not affected. The patient's condition was stationary for about a fortnight, when signs of improvement began, and this continued gradually until January 22nd, 1904, when he was discharged with only a slight inability to walk.

The case is unique, as it is, I believe, the first instance of poison by ratsbane in man which is recorded. The symptoms observed in this case have been observed in sudden cases of paralysis of the lower extremities in young persons of both sexes and of various ages, but especially in those between the ages of twenty and forty.

The origin of this disease has been veiled in great obscurity, even experienced medical men have been baffled in their efforts to discover it. The disease has generally been regarded as mysterious by the people. For the country doctors, who have the true knowledge of the cause of the disease, keep it a secret, attributing it to some mysterious influence of the devil, or to witchcraft or something occult, and thereby make much profit from their knowledge, and wield great power over the masses.

There is now no doubt in my mind that the many cases of sudden illness resulting in paralysis are due to poison by the ratsbane, and the numerous deaths commonly reported to be from poison may also be attributed to the effective use of this substance. The symptoms observed in the domestic animals when under the influence of this poison are the same as in man. Cats and dogs which may happen to be poisoned by eating fish sprinkled with the powdered fruit show in a few minutes great distress, they vomit, rush about frantically, and their legs soon become paralysed. They then lie down helplessly, breathing quickly, the forearm twitching and quivering; they ultimately die, apparently from paralysis of the respiratory muscles.

This poison is derived from the fruit of the *Chailletia toxicaria*, natural order Chailletiacæ. It grows in West Africa and South America. In Sierra Leone it is commonly called "broke back," from its effect in producing paralysis of the lower limbs. In the Hinterland it is known by the Mendis as "magbevi," and by the Timnes as "manuch."

POISONING BY CHELIDONIUM MAJUS.

Source and Method of Occurrence.—The plant is a fairly common English wild flower belonging to the natural order Papaveraceæ. It occurs in nearly every county of the British Isles. The following case is taken from the daily papers in 1904. The editor was acquainted with a gentleman interested in the case, and is able to confirm the account in that the accident did occur and that the plant was found freely growing in the field; but he is unable to confirm the account by quoting a case as having occurred to a human being, though the juice is popularly believed to be irritating to the skin, and the plant has been suggested as a local application for the cure of cancer.

A somewhat remarkable case of poisoning has occurred on the farm of Mr. George Freir, of Littleworth. Of a herd of twenty-two valuable pedigree shorthorn cattle five have died under suspicious circumstances. Mr. H. C. Reeks, veterinary surgeon, was called in, and, from the history given him of the cases, determined at once that the cattle had been poisoned, and that the poison, whatever it might be, existed in the field in which the cattle were grazing. A careful investigation of the field was then made, and a short search revealed the presence of large quantities of a poisonous plant, the common celandine, known to botanists as *Chelidonium majus*, and better known to country people as tetter-wort or wart-wort. Feeling somewhat doubtful about this being the cause of the mischief, Mr. Freir, acting on Mr. Reeks' suggestion, forwarded specimens of the plant to one or two well-known experts. In each case Mr. Reeks' opinion as to the dangerous nature of the plant was fully confirmed. From a conversation we have had with Mr. Reeks, we gather that this plant has long been known to botanists as a virulent and dangerous poison. That cases of poisoning from it are not more frequent may be attributed to the fact that the plant almost invariably grows in hedgerows and on waste places; that is to say, out of the way of the cattle's ordinary run.

Inasmuch as the plant is said by some people to be a cure for cancer, it is not at all improbable that cases of its fatal action may arise in human beings. It has an acrid yellow juice, in which its virtues are supposed to exist.

Poisoning by Cicuta virosa (Water Hemlock).

Source and Method of Occurrence.—The water hemlock, or cowbane, has given rise to several fatal accidents, its roots having been mistaken for parsnips. The whole of the plant is poisonous; but the roots are the most active, especially when gathered early or late in the year. It is, luckily, rather a rare plant.

Symptoms and Effects.—The symptoms produced by the roots are giddiness, dimness of sight, headache and difficulty of breathing. There is burning pain in the stomach, with vomiting, and these symptoms are accompanied by heat and dryness of the throat. Convulsions have been observed to precede death. In the cases of three children, who died in convulsions from this poison, Mertzdorff found an injected state of the mucous membrane of the stomach, with redness of the air-passages, as well as of the stomach at the cardia and pylorus. The vessels of the brain and the sinuses were filled with dark liquid blood (Wibmer, "Cicuta," p. 119). In a fatal case which occurred to Wepfer, the patient, a man, æt. 20, who had eaten a large quantity of the *root*, was found with his face swollen and his eyes projecting. He breathed with great difficulty, and foamed at the mouth. He was seized with a severe epileptic fit: his limbs assumed a tetanic stiffness, and there was spasmodic breathing. He was quite unconscious, and soon died. The only marked appearances were fluidity of blood, and patches of redness on the mucous membrane of the stomach (Wibmer, *loc. cit.*). A man ate a portion of the root of this plant in a cooked state. It had a sweetish taste, and was of the colour of a parsnip. Half an hour after his dinner he felt giddiness, and great dryness of the throat. He walked home with great difficulty, his legs being very unsteady, and all surrounding objects appeared to him as if they were advancing or receding. In about an hour and a half the legs were paralysed, the arms benumbed, and their movements weak; the face was anxious and flushed, and he had an apprehension of death. The skin was warm and dry—the pulse 90. An emetic was given.

In two hours he was able to stand, and with difficulty walked across the room. He passed much urine, and had hallucinations. In seven hours the legs were cold, pupils dilated, skin and throat dry, with occasional delirium. There was no purging. In two days he recovered (*Lancet*, 1871, 2, p. 396). In the *Pharm. Jour.* for June, 1872, p. 1063, two fatal cases are reported. The boys ate the roots, supposing them to be wild celery. Symptoms of poisoning soon came on. They suffered from severe convulsions, with trismus (lockjaw) before death.

POISONING BY CINNAMOMUM CAMPHORA.

Source and Method of Occurrence.—Camphor is a natural product from the plant Cinnamomum camphora. Attempts have been made with more or less success to produce it artificially. It has never been used for homicidal purposes, accident (and ? suicide) accounts for all the cases recorded.

Toxicity and Fatal Dose.—Camphor cannot be said to be a very poisonous substance. It acts by first stimulating, and later exhausting the cardiovascular and respiratory centres.

The smallest recorded dose in an adult that has caused alarming symptoms is twenty grains, and thirty grains have proved fatal to an infant of eighteen months.

Symptoms.—In the cases that have been observed, its effects have been somewhat varied, but on broad survey may be said to very closely resemble those of alcohol, which, in fact, has much the same physiological action as camphor.

A woman swallowed about *twenty grains* of camphor dissolved in rectified spirit of wine mixed with tincture of myrrh. In half an hour she was suddenly seized with languor, giddiness, partial loss of sight, delirium, numbness, and tingling and coldness of the extremities, so that she could hardly walk. The pulse was quick and respiration difficult, but she suffered no pain in any part. On the administration of an emetic, she vomited a yellowish liquid smelling strongly of camphor. In the evening the symptoms were much diminished, but she had slight convulsive fits during the night. The next day she was convalescent; the difficulty of breathing, however, continued more or less for several weeks. This is the smallest dose of camphor which appears to have been attended with serious symptoms in an adult. An infant of fifteen months died from the effects of some camphorated oil given to it by mistake. Convulsions ensued, and death took place in thirteen hours. Three cases of poisoning by camphor are reported by Schaaf, one of which proved fatal. A woman gave about thirty grains (half a teaspoonful) of powdered camphor to each of her three children as a vermifuge. Two of the children were respectively of the ages of three and five years; the third was an infant aged eighteen months. The first symptoms were paleness of the face, with a fixed and stupid look. Delirium followed, with a sense of burning in the throat, great thirst, vomiting, purging, and convulsions; and in one child the convulsions were most violent. The two elder children, after suffering thus for three hours, fell into a comatose sleep, and on awaking the symptoms passed off. The infant died in seven hours, not having manifested any return of consciousness from the first occurrence of convulsions (*Jour. de Chim. Méd.*, 1850, p. 507). The severity of the symptoms is fully explained by the large quantity administered and the age of the children. In one case (*Med. Gaz.*, vol. 11, p. 772), 120 grains were taken by a physician, and all that he experienced was lightness in the head with great exhilaration. There was no derangement of the stomach or bowels. He slept profoundly for some hours, and awoke very weak and exhausted. He also perspired greatly during sleep. It is difficult to draw any conclusion from this case, as the quantity taken was conjectural, and the patient was not seen by any person while labouring under the effects of the poison. A soldier took a large quantity of camphor daily. For three days it had no effect. On the fifth day he suffered from great pain and a burning sensation in the stomach. His head was painful: there was giddiness, with an incessant desire to walk about, although, like a drunken man, he could hardly keep on his legs. He soon became completely insensible—the limbs were cold, the face pale, the body convulsed, and the pupils dilated. These symptoms were followed by an irresistible desire to sleep. In two or three days he recovered (*Med. Times and Gaz.*, 1858, 2, p. 645).

In 1882, a man was admitted into Guy's Hospital, after having swallowed about five fluid ounces of soap liniment. This quantity would contain 150 grains of camphor. His skin was cold and clammy. The pupils were dilated, and did not respond to light. He was quite unconscious, and the conjunctiva of the eye was insensitive to touch; the jaws were tightly set. The limbs were relaxed, but became rigid when handled. Pulse 120. The respirations were stertorous, and twenty per minute. An emetic had been successfully administered to the patient before his admission. The stomach-pump was then applied with difficulty, in consequence of the rigidity of the jaw; and only a small quantity of mucus and a few scraps of food were recognised in the fluid removed. The temperature was 2° F. below the normal. A subsequent attempt to administer castor oil failed, as he was unable to swallow. Five hours after his admission consciousness returned. He vomited, had very little muscular power, and fell on attempting to leave his bed. Ten hours after admission the skin was hot and dry, the pupils were still dilated, the pulse 108, the respirations very rapid (thirty-eight), and though conscious he was drowsy. The tongue was dry, brown, and tremulous. Muscular rigidity had disappeared. He now made a rapid recovery.

Treatment.—Must be conducted on general principles (*vide* pp. 334, *et seq.*).

Post-mortem Appearances.—Nothing characteristic except the smell.

Analysis.—There appear to be no specific tests for camphor better than its smell, taste, and familiar physical properties.

A case of poisoning by camphor would be recognised by the odour of the breath, a symptom which would attract the attention of a non-professional person. The presence of this substance in the stomach would be at once indicated by its odour (*vide* also "Brit. Pharm.," 1898).

Cases.—An instance is recorded by Borkholz (*Petersburg Med. Woch.*) of recovery of a young girl who had taken fifteen grammes of camphor, suspended in water. After washing out the stomach, chloral and potassium bromide were administered as antidotes, the cure being complete in a few days. Toxic symptoms in this case did not supervene until after the lapse of two hours, when intense cephalalgia, vomiting, convulsions, and coma supervened, the respiration being rapid and the pulse full. Recovery is attributed to the fact that before taking the dose the patient had partaken of a full meal, largely composed of carbohydrates, which may have formed in the intestines the non-toxic glyco-camphoric acid. The author recommends the use of large doses of sugar as an antidote (*Bull. Comm.*, 27, 35, p. 1; *Pharm. Jour.*, 1899, p. 492).

The following from the *B. M. J.*, 1, 1898, p. 299, is a somewhat unusual case, reported by Dr. Wilkinson:

> A Chinese coolie's wife brought a little girl, aged five years, to my surgery, and gave the following history: "By mistake the child had been given half a (Chinese) teacupful of crude camphor oil instead of tea." This oil is used by the natives as a preventive for mosquito bites, and contains from 40 per cent. to 50 per cent. of crystallisable drug which precipitates after standing for several days.
>
> The mother informed me that the accident had occurred about one hour and a half before coming to me, and that, directly after swallowing the oil, the child had fallen on the floor in convulsions, which lasted twenty minutes; the eyes were wide open, the face livid, hands clenched, feet cold, and legs outstretched. Towards the end of the fit the patient frothed at the mouth and vomited, but the ejecta were not blood-stained. After vomiting the child drank half a cupful of water, and was then brought to me. When I saw it it had just vomited slightly for a second time; it looked pale and languid, and was apparently nauseated. The pulse was a hundred, the temperature not taken.
>
> I immediately tried to promote emesis by ipecacuanha, and after pushing the drug succeeded in obtaining very free and repeated results. The vomit, beyond smelling strongly of camphor, presented no other peculiarities, and was quite free from blood.
>
> The little patient soon fell asleep, and after a time was taken home. I was informed next day that she was running about and playing, and apparently quite well.
>
> To say nothing of the camphor still held by the oil in solution after the precipitate had formed, and only reckoning the quantity by weight of the latter, this child must have swallowed at least from one hundred grains to two hundred grains of pure drug!

For a case with very severe collapse after eating three drachms of pure camphor, *vide B. M. J.*, 2, 1895, p. 660.

Poisoning by Citrullus Colocynthis (Colocynth).

Colocynth has occasionally produced death, preceded by symptoms of gastric and intestinal irritation, and excessive purging. It is also perhaps occasionally used for procuring abortion. Christison recorded the death of a young woman from a teaspoonful and a half of the powdered pulp. Roques states that less than sixty grains of the powder, in decoction, has proved fatal; whilst recovery has taken place after three times that amount (Husemann, "Handb. d. Toxicol.," p. 625).

Poisoning by Claviceps purpurea (Ergot).

Source and Method of Occurrence.—"Ergot" as commonly seen in bulk is the grain of rye, spoilt and permeated through and through with the threads of a fungus (Claviceps purpurea), so that the grain is practically composed of the fungus.

Ergot has long enjoyed a reputation for its action upon the uterus (its action is essentially that of causing unstriped muscle to contract, therefore powerfully affects the uterus, consisting as this organ does almost entirely of unstriped muscle) and hence is a favourite drug to administer for the purpose of procuring abortion, and a large number of cases of poisoning by it have given rise to criminal charges for abortion.

The reader will find a collection of cases, illustrating the properties of this drug, in Von Jaksch ("Vergiftungen," Leipzig, 1910). For its use in abortion, *vide* pp. 160, *et seq.*

Toxicity and Fatal Dose.—The active principles upon which ergot depends for its action are even now not thoroughly understood; ergotin, ergotinin, cornutine (Kobert) and sclerotic acid have each had ascribed to them great activity ("Extra Pharm.," pp. 241 *et seq.*), but to whichever of them the honour may belong it cannot be considered a very powerful poison so far as life is concerned; the danger of it lies in the circumstances under which it is given. For further discussion on ergot and its pharmacology, *vide* a paper by Dr. Alex. Goodall in the "Edin. Med. Chir. Trans." for 1909.

The medicinal dose of the powder in uterine diseases is from twenty to thirty grains. It is employed in a larger dose (from twenty to sixty grains at intervals of half an hour) to excite uterine action either for abortion or parturition. The dose of the tincture is half a drachm; this is equivalent to seven grains of the powder. The dose of the liquid extract, when employed for the purpose of exciting uterine action, is half a drachm every half-hour for three or four doses.

The minimal fatal dose is quite unknown. It does not readily cause death in one large dose, but its fatal operation appears to be more strikingly developed by its long-continued use in small or medicinal doses.

Symptoms.—These must be divided into those of acute poisoning by the drug, and those of the chronic effects of eating bread, etc., made with flour containing some proportion of affected flour. In doses of from half a drachm to two drachms, ergot in powder has caused nausea, vomiting, dryness of the throat, great thirst, aversion from food, pain in the abdomen, slight purging, pain in the head, stupor, and dilatation of the pupils. For the symptoms of chronic poisoning by ergot the reader is referred to an article by Prof. Clifford Allbutt, published in his "System of Medicine," vol. 2, p. 793 *et seq.* The symptoms essentially consist in gangrene due to disease of the blood-vessels distributed to the parts, this disease in turn being due to the violent action of the ergot on the muscular coat of the arteries The disease has but little interest for the medical jurist, concerning rather the medical officer of health.

Post-mortem Appearances.—Nothing at all characteristic in the tissues, but particles of the powder may be seen.

Analysis.—The powder of ergot has a faint fishy smell; this is specially observed when it is rubbed with a solution of potash. This alkali dissolves it in part, and the solution acquires a dingy-red colour. In the form of tincture, alcoholic or ethereal, the peculiar fishy odour of the extract when treated with potash is well marked. This is owing to the liberation of trimethylamine. It may, however, be concealed by other odours. Sometimes small particles of ergot, presenting a pink-red colour in the dark external coat, may be detected in the sediment by the microscope. When ergot has been taken in powder, fragments of it may be found scattered over the lining-membrane of the stomach or bowels; these may be identified by the characters described. The ethereal tincture of ergot, evaporated to an extract, yields a yellowish-coloured oil, which if any of the colouring matter of ergot is present, acquires a reddish colour when heated with a solution of potash. It also evolves a fishy odour of trimethylamine.

The colour produced by potash or other alkalies, with ergot of rye, is purely a pigment reaction, and therefore only occurs when any portion of the coloured coat of the ergot is present. As the pigment is not soluble in alcohol and ether, the action of alkalies upon the residues of these solutions is sometimes negative. In old and damaged preparations the fat is rancid, and the fatty acid may dissolve a portion of the coloured pigment, which will then be turned of a rose or carmine-red colour by alkalies. A fresh specimen will give nothing to ether that will be coloured by the addition of an alkali.

It is not probable that a sufficient quantity of this substance will be found in the body of a person to whom it is alleged to have been given, to allow of the separation of any of the active principles. The medical jurist must reply upon the physical properties of the fungus if he can obtain any of it. A spectroscopic examination of the red alkaline solution of colouring matter presents nothing characteristic. Old samples smell strongly of ammonia, and contain acari (mites). The procedures described on p. 352 should, nevertheless, be undertaken.

Poisoning by Cocculus Indicus (Levant Nut).

Source and Method of Occurrence.—This is the fruit or berry of the *Anamirta Cocculus* (*Levant Nut*), imported from the East Indies. The berry contains from 1 to 2 per cent. of a poisonous principle (*Picrotoxin*). The shell or husk contains no picrotoxin, but a non-poisonous principle called menispermin. The seeds, in powder or decoction, give rise to nausea, vomiting, and griping pains, followed by stupor and intoxication. There are only two well-authenticated instances of this substance having proved fatal to man. Several men suffered from this poison in 1829, near Liverpool; each had a glass of rum strongly impregnated with cocculus indicus. One died that evening; the rest recovered (Traill's "Outlines").

Porter, ale and beer have owed their intoxicating properties in some instances to a decoction or extract of these berries. The fraud was formerly perpetrated by a low class of publicans. They reduced the strength of the beer by water and salt, and then gave to it an intoxicating property by means of this poisonous extract. A medical man consulted the author some years since, in reference to the similarity of cerebral symptoms exhibited by several of his patients in a district in London. It was ascertained that they were supplied with porter by retail from the same house. Cocculus indicus is sometimes used by robbers to intoxicate their victims.

Cocculus indicus has been frequently used for the malicious destruction of fish and game. In one instance referred to the author, there was reason to believe that 270 young pheasants had been poisoned by grain soaked in a decoction of this substance. *Barber's* *poisoned wheat* for the destruction of birds owes its poisonous properties to cocculus indicus (Horsley).

Symptoms.—The effects produced by this drug are remarkable; there is a strong disposition to sleep, and at the same time wakefulness. There is a heavy lethargic stupor, with a consciousness of passing events, but a complete loss of voluntary power. It is a kind of nightmare feeling, altogether different from healthy sleep. Of the second case above, the following details have been published:—

A boy, æt. 12, was persuaded by his companions to swallow forty grains of a composition used for poisoning fish. It contained cocculus indicus. In a few minutes he perceived an unpleasant taste, with burning pain in the gullet and stomach, not relieved by frequent vomiting, and pain extending over the whole of the abdomen. In spite of treatment, a violent attack of gastro-enteritis supervened, and there was much febrile excitement, followed by delirium and purging, under which the patient sank on the nineteenth day.

On inspection, the vessels of the pia mater were congested with dark-coloured liquid blood. There was serous effusion in the ventricles of the brain, and the right lung was congested. In the abdomen there were all the marks of peritonitis in an advanced stage. The stomach was discoloured, and its coats were thinner and softer than natural (Canstatt's *Jahresbericht*, 1844, 5, 298).

Analysis.—One method of detecting this poison in alcoholic liquids consists in distilling off the alcohol, and then testing the extract by physiological or chemical processes. The extract containing cocculus indicus is intensely bitter, and soon produces in an animal peculiar symptoms. One-twentieth of a grain of picrotoxin kills rabbits with peculiar opisthotonic convulsions. Fishes when immersed in water containing this substance make strange, sinuous movements, and fall powerless on the side (*B. M. J.*, 1875, March 27th, *et seq.*). Röber found that frogs are affected with tonic and clonic convulsions, and a peculiar inspiratory tetanus, which causes an inflated state of the abdomen. He thinks that this special condition is characteristic of the administration of picrotoxin to these animals. For some remarks on this adulteration of beer and other liquids, and a process for separating the poisonous principle, picrotoxin, by amylic alcohol, see *Chem. News*, March 12th, 1864, p. 123.

Picrotoxin.—The poisonous principle of the berry of cocculus indicus crystallises in slender hexahedral prisms, having a silky lustre. It is soluble in 150 parts of cold water, but is more soluble in boiling water, and the solution has a very bitter taste. When heated in a tube, picrotoxin, like digitalin, evolves an acid vapour. Hydrochloric acid dissolves it without change of colour. It is soluble in alcohol, ether, chloroform, and in amylic alcohol. Sulphuric acid imparts to it an orange-yellow colour, which becomes violet, passing into brown on the addition of a minute fragment of bichromate of potassium. Strong nitric acid dissolves it without any change of colour. Tannic acid and potassio-mercuric iodide do not precipitate it from its solutions. When boiled with a solution of potash and sulphate of copper, it reduces the solution somewhat like grape-sugar. The chemical tests are, however, imperfect.

Langley has shown that picrotoxin may be separated from many of the poisonous alkaloids by taking advantage of its peculiar chemical properties. It does not combine with acids to form salts, but readily with bases. Thus water containing a small quantity of potash will dissolve one-sixth or one-eighth part of its weight of picrotoxin. Water thus alkalised will, it is well known, readily yield most of the alkaloids to ether, when this liquid is shaken with the solution; but if the liquid is strongly acidulated, most of the alkaloids remain combined with the acid, while the ether shaken with the liquid entirely removes the picrotoxin. Thus, in examining beer supposed to be adulterated with cocculus indicus, the liquid should be acidulated with hydrochloric acid, and then shaken with twice its volume of ether. The ethereal solution thus obtained, when spontaneously evaporated, leaves the picrotoxin in crystals. Langley states that by this process he has detected so small a quantity as 1-750th of a grain of picrotoxin in a pint of ale. The stomach of a cat which had been poisoned was treated with alcohol, and the solution evaporated to dryness. Acidulated water was poured on the residue, and the picrotoxin with some organic matter was dissolved. The acid liquid was shaken with ether, and crystals of picrotoxin were obtained by the evaporation of the ethereal solution (*Pharm. Jour.*, December, 1862, p. 277). It is supposed that two or three grains would be a fatal dose for an adult person.

Poisoning by Colchicum Autumnale.

Source and Method of Occurrence.—The corms and seeds of the plant known as Colchicum autumnale are both in official use in the Pharmacopœia. The plant grows in England, but is certainly not common. Its flowers are showy, and it would be risky for children to eat them, but practically no cases are recorded of this form of accidental poisoning; all such arising from the injudicious use of the medicinal preparations. The only criminal case the editor is aware of is the one recorded below (Cases).

Many quack remedies for gout essentially consist of parts of the plant. Blair's Gout Pills consist of the ground corms of colchicum. A man, æt. 50, took twenty-eight of these pills in the course of four and a half days. He had nausea, griping pains in the abdomen, diarrhœa, hiccough, and vomiting; followed by stupor, convulsions, twitchings, and death in fourteen days. The pills, which were hard, were found by Beyte to yield three-fifths of a grain of colchicine (*Lancet*, 1881, 1, p. 368). The tincture, five to fifteen minims, vinum, ten to thirty minims, and the extract, a quarter to one grain are the official preparations and doses.

Toxicity and Fatal Dose.—The toxicity of the plant is due to the presence in it of a poisonous alkaloid—*Colchicine*—the effects of which on animals are similar to those of *Veratrine*, the alkaloid existing in White Hellebore.

It is difficult to estimate the fatal dose, but judging from the above case, it would seem that a grain would be likely to produce fatal effects. The alkaloid as a remedy (for gout) is not official, but its dose is one thirty-second to one-sixteenth of a grain, and it must be considered as very poisonous.

A gentleman swallowed by mistake one ounce and a half of vinum colchici. He was immediately seized with severe pain in the abdomen; other symptoms of irritation came on, and he died in seven hours. In another instance, in which an ounce of the wine was taken, death occurred in thirty-nine hours (Schneider's "Annalen," vol. 1, p. 232). In a case in which a similar dose was taken, the person recovered after suffering from cramps in the limbs and twitching of the tendons (*L'Union Méd.*, August 24th, 1848). **Three and a half drachms** of the vinum seems to be the smallest recorded single dose which has proved fatal; death ensued on the fourth day.

Symptoms.—A woman, æt. 56, suffering from rheumatism, for whom wine of colchicum had been prescribed, took by mistake an ounce of the wine of the seeds, in divided doses, in twelve hours. She suffered from nausea, violent and profuse vomiting, slight purging, with heat and burning pain in the throat, great thirst, cold clammy skin, feeble pulse, pain in the stomach, and pain in the forehead. Inflammation of the stomach supervened, and the retching, vomiting, thirst and pain continued for three days. She then recovered (*Amer. Jour. Med. Sci.*, January, 1857 ; and *Brit. and For. Rev.*, 1857, 19, 499). In other cases profuse purging has been the most prominent symptom, followed by death from exhaustion (*Pharm. Jour.*, July, 1861, p. 45). In one instance, in which two ounces of the wine were taken, the symptoms did not come on for an hour and a half; they were then copious vomiting of a yellow fluid, severe pain in the abdomen, with great tenderness, tenesmus, and thirst. The patient died in forty-eight hours without being convulsed or manifesting any sign of cerebral disturbance (*vide* also *Lancet*, 1, 1903, p. 1254).

In the four persons below the symptoms were as nearly as possible of the same character—burning pain in the throat and stomach, intense thirst, violent vomiting and purging, coldness and clamminess of the skin, excessive depression, and great weakness. The pulse was small and weak, and death appeared to take place from exhaustion, without convulsions or loss of consciousness. Of these persons, one died on the second, one on the fifth, one on the eighth, and one on the fourteenth day. In most of the cases the poison was probably given in divided doses : in the last case the symptoms always appeared every evening after the deceased had taken the tea prepared by the prisoner.

Treatment.—There is no specific antidote to colchicine, and treatment must be on general principles (*vide* pp. 334, *et seq.*).

Post-mortem Appearances.—Nothing characteristic has been found, but signs of gastro-intestinal irritation are sometimes seen.

Analysis.—Colchicum, in the form of tincture, possesses a warm aromatic taste and a peculiar odour. Colchicine may be separated from liquids containing it by a process similar to that described for strychnine.

A drop of nitric acid, S.G. 1·4, brought in contact with colchicine, produces a violet colour, which changes to brownish-yellow. One part of ammonium vanadate dissolved in two hundred parts of sulphuric acid produces a green coloration (sometimes very evanescent, and not distinct except with the pure alkaloid), which changes to a brownish-violet ; the reagent should be freshly prepared. The physiological test does not afford decisive information; the conclusions arrived at by a committee of French experts, who were appealed to in a case of suspected colchicine poisoning, were, that experiments on animals do not afford the means of determining that poisoning by colchicine has taken place.

Ogier was able to obtain the reactions of colchicine isolated by the usual process, from the exhumed bodies of dogs which he had poisoned with it five and a half months before. In the bodies of animals poisoned with it, Oblonski detected colchicine four and a half months after death (Mann).

Cases.—A woman, after having been tried and acquitted for an attempt to poison with oil of vitriol a man with whom she cohabited, was convicted (*R.* v. *Catherine Wilson*, C. C. C., September, 1862) of the murder of a Mrs. Soames, who had died suddenly while nursed by the prisoner six years previously. The body was exhumed, but no poison was found in the remains; yet the medical and other circumstances, as well as the conduct and correspondence of the prisoner, proved to the satisfaction of the court that deceased had been destroyed by vegetable poison, most probably colchicum, with the noxious properties of which she was proved to have been well acquainted. From the facts which transpired in reference to this trial, it appeared that the deceased was one of four persons who had at different dates fallen victims to the acts of this woman. 1st, Peter Mawer, who died in October, 1854: the body was exhumed in 1862, but no poison was detected. 2nd, Mrs. Jackson, who died in December, 1859: the body was exhumed in January, 1860, and no poison was detected. 3rd, Mrs. Atkinson, who died in October, 1860: the body was exhumed in May, 1862, and no poison was detected. 4th, Mrs. Soames, above mentioned. All these persons died speedily while in a state of health, under similar symptoms, and without any apparent natural cause to account for death. The symptoms as a whole were not reconcilable with any known disease, and they only appeared after the prisoner was proved to have administered, under some pretence or other, food or medicine, the bottle which she employed for this purpose being kept locked up or in her own possession. The motive for the murder in each case was the acquisition of property. Two other attempts at murder, which failed, led to the inference that colchicum, either in wine or brandy, was the substance which this woman employed.

[Grave doubts have, however, been entertained by experts as to the kind of poison administered; the author's opinion as to its being colchicum is not universally shared by toxicologists.—Sir Thos. Stevenson.]

McGregor Maclagan collected fifteen cases of poisoning by colchicum (*Month. Jour. Med. Sci.*, 1852, p. 1). Roux relates the poisoning of five soldiers by the administration of two ounces of wine of colchicum in each case, in mistake for quinine wine. All died (*Union. Med.*, 1855, No. 36). Keller reported a case of poisoning by three-fifths of a grain of the alkaloid colchicine. The patient, a woman, æt. 20, recovered ("Ber. d. Krankenanstalt Rudelfstiftung in Wien," 1857).

The following is taken from the *B. M. J.*, 2, 1903, p. 1272. It is reported by Dr. L. G. Davies:—

On being recently summoned hurriedly to Mr. X., aged fifty-eight, I found him with a typically "abdominal facies"—drawn, anxious, and dusky; bluish lips and nails; quick, shallow respirations; small and quick pulse, and clammy, pale skin. I knew him to be ordinarily a healthy, temperate man, though slightly gouty. He complained of intense cutting epigastric pain, of sudden onset one and a half hours earlier, beginning with vomiting of such yellow fluid "all over the road," and several violent actions of the bowels, the motions being profuse and sanguineous. The abdomen was tender all over, the temperature 96·5°.

The clinical picture was that of a sudden serious abdominal lesion, but local indications were wanting, as was also any proof of the existence of actual involvement of the peritoneum.

Inquiry as to recent ingesta elicited that he had taken on an empty stomach some two and a half hours before, two "Blair's gout pills," and the diagnosis seemed to lie between (1) pill poisoning, (2) ptomaine poisoning, (3) abdominal lesion, for example, perforation of appendix. The history negatived (2) and (3), but the patient's state inclined one strongly to (3). Could these two pills possibly do all this to a man?

I diagnosed colchicum poisoning from the Blair's pills, administering appropriate treatment. Recovery followed the use of sedatives and carminatives, but not before muscular twitchings and choleraic symptoms had appeared. A month before he had taken two of these pills, with similar but much less intense symptoms. Murrell notes a case of colchicum poisoning from these pills as being recorded in the *Lancet*, vol. 1, 1881, p. 368. The symptoms agree generally with those of colchicum poisoning noted by Murrell and by Ewart, the two chief authors accessible to me.

Intense thirst and partial vesical paralysis were also observed. The yellow vomit described by Murrell was well marked. The patient assured me that only two pills were taken, "and they would be the last two of that sort."

A somewhat singular death from colchicine occurred in France. A man, aged forty-three years, the subject of nephritis and gout, was ordered a capsule containing a quarter of a milligramme of colchicine and twenty grammes of salicylate of methyl eight times a day. To cut short an attack he took twelve capsules within the space of an hour. He vomited mucus tinged with black blood, passed blood in the motions and urine, and had muscular tremors which were exaggerated by excitement. The muscles became tender. Ecchymotic spots appeared on the limbs. The urine at the time of death—ten days after the ingestion of the poison—contained colchicine. The usual symptoms of colchicine poisoning—headache, abdominal pain, abundant vomiting, and diarrhœa—were absent (*Lancet*, 2, 1903, p. 1798).

POISONING BY CONIUM MACULATUM.

Source and Method of Occurrence.—The spotted hemlock is a very common plant indigenous in Great Britain. Its poisonous properties reside in the seeds, leaves, and roots. It belongs to the natural order umbelliferæ.

The case of Socrates is the only case in which the plant has been used for judicial purposes. But it has been the subject of a charge for murder.

In a case which was the subject of a trial for murder (*R.* v. *Bowyer*, Ipswich Sum. Ass., 1848), the child died in one hour after swallowing part of a teacupful of a decoction of hemlock, alleged to have been administered by the mother. The child sipped the decoction, until it lost the power of holding the cup; it became insensible and paralysed, and died in the chair in a sitting posture. There were no morbid appearances, and no hemlock leaves were found in the stomach, these having subsided in the cup. The child had been poisoned by the upper stratum of clear liquid. The mother was acquitted for want of proof of administration, the death of the child having taken place in secrecy.

In the year 1861 Dr. Jahn killed his mistress in a few minutes by a dose of ten or fifteen drops of conine. Violent palpitation of the heart was the most prominent symptom (Husemann, "Die Pflanzenstoffe," p. 269).

Very few cases are recorded on poisoning by this plant, and most of them are of an accidental nature.

A medical electrician suffering from facial spasm took (beginning four hours after the last of a previous series of divided doses of a fluid extract of conium amounting in the aggregate to one hundred and eighty drops) at 4.10, 4.40, and 5.15 p.m., fifty minims (one hundred and fifty in all) of "Squibb's Fluid Extract." The first dose produced dizziness and muscular relaxation; the second, great muscular weakness, inability to stand, and thickening of speech, without relief of the spasm; the third, immediately, some nausea, and tremors about the chest. At 6.10 p.m., there were nausea, intense muscular weakness, partial dropping of the eyelid (ptosis, a common symptom), double vision, and great difficulty of speech. The pulse was sixty. Shortly after this he became unable either to speak or to swallow. He made signs for electricity, and, on being asked whether the direct or the faradic current, indicated the latter, and also the place of application of the electrodes, but was unable to hold one of the latter. Shortly after this he dropped back dead (*The Sanitarian*, June, 1875).

It has been mistaken for parsley. It is hardly credible that a mistake of this kind should be made, yet through carelessness and ignorance accidents have occurred. In 1864, a lady and two of her children were seized with symptoms of poisoning soon after dinner. The medical men who were called in examined the remains of some soup which had been eaten, and they detected fragments of the leaves of hemlock amongst the herbs which had been used to flavour the soup. Under treatment, the symptoms abated in a few hours, but these persons did not entirely recover until after two or three days. It turned out that the hemlock had been gathered in the garden belonging to the family, where it was growing side by side with parsley. As the parsley was raised from seed, it is probable that hemlock-seed had been accidentally mixed with it by the seedsman, and thus the accident had occurred. No deaths from it were registered in 1901.

The official preparations are: Tinct., dose $\frac{1}{2}$ to 1 drachm; succus, dose 1 to 2 drachms and an ointment.

Toxicity and Fatal Dose.—The poisonous properties of hemlock are well known to reside in its alkaloid, conine, of which Dr. Luff says "one drop is considered to be a fatal dose." Its action is almost entirely on the peripheral nerves, and death is probably brought about by this action being exerted on the vagi.

The difference in the symptoms depends upon which nerves first feel the effects of the drug, a good reason for not using the drug in chorea.

Duration.—The symptoms come on after a variable interval required for digestion and absorption, and rather rapidly, *i.e.*, in three or four hours, gradually increase in the severity of the paralysis, and kill by involvement of the cardio-respiratory nerves.

Symptoms.—As in poisoning by most plants, if portions be eaten there may be symptoms (vomiting, nausea, diarrhœa) of gastro-intestinal irritation before the more specific effects of the conine are exhibited.

The effects produced by hemlock have not been uniform; in some instances there have been stupor, coma, and slight convulsions; while in other cases, the action of the poison has been chiefly manifested on the nerves—*i.e.*, it has produced paralysis of the muscular system A peculiar muscular debility sets in; the lower limbs become weak, and eventually paralysed; the paralysis advances upwards, eventually reaching the respiratory muscles. There is dyspnœa, anxiety in the region of the heart, and towards the close of life convulsions, consciousness being previously intact. The pupils are dilated, though not to the same extent as when a solanaceous plant has been taken. When the respiration is affected there is marked blueness of the surface of the body.

A man ate a large quantity of hemlock plant, by mistake for parsley. In from fifteen to twenty minutes there was loss of power in the lower extremities; but he apparently suffered no pain. In walking, he staggered as if he was drunk: at length his limbs refused to support him, and he fell. On being raised, his legs dragged after him, and when his arms were lifted they fell like inert masses, and remained immovable. There was complete paralysis of the upper and lower extremities within two hours after he had taken the poison. There was a loss of the power of swallowing, and a partial paralysis of sensation, no convulsions, but only slight occasional motions of the left leg; the pupils were fixed. Three hours after eating the hemlock, the respiratory movements had ceased. Death took place in three hours and a quarter; it was evidently caused by gradual asphyxia from paralysis of the muscles of respiration; but the intellect was perfectly clear until shortly before death.

Treatment.—Empty the stomach and give general stimulants, alcohol, coffee, etc. Of antidotes strychnine is the best, but the antagonism is not absolute (*vide* p. 338); it should be given subcutaneously in doses of $\frac{1}{30}$ grain, repeated if necessary in an hour.

Post-mortem Appearances.—Beyond the possibility of bits of the plant being found in the stomach, there will not be found any post-mortem visible changes. In the case of the man (above), on inspection, the stomach contained a green-coloured pulpy mass resembling parsley. The mucous coat was much congested, especially at its greater end: here there were numerous extravasations of dark blood below the membrane, over a space of about the size of the hand. The intestines were healthy, here and there presenting patches of congestion in the mucous coat. The blood, throughout the body, was fluid, and of a dark colour. A portion of the green vegetable pulp was identified as part of the leaves of the *conium maculatum*. Some of the leaves bruised in a mortar, with a solution of potash, gave out the peculiar odour of the alkaloid conine (*Edin. Med. and Surg. Jour.*, July, 1845, p. 169).

Analysis.—Hemlock is known from most other plants which resemble it by its large round smooth stem, with dark purple spots. The leaves are of a dark-green colour, smooth and shining. Every portion of the plant has a peculiar and disagreeable smell when rubbed or bruised, resembling cats' urine, or, according to some, the odour of mice. It is strongly brought out when the stem, leaves, or seeds are rubbed with a solution of caustic potash. The *seeds* of hemlock are peculiar in their form, and are easily distinguished from the seeds of other umbelliferous plants. A person was poisoned by a decoction of *leaves* of hemlock, and no leaves were found in the stomach or bowels, but the stomach had been emptied and the contents lost, and hence no trace of conine was found. The prisoner first gathered the *Anthriscus sylvestris* by mistake for *Conium maculatum*, but it was proved that she had afterwards gathered the leaves of hemlock. A leaf of each of these plants was copied by photography, and produced as evidence in Court.

The determination of the presence of fragments of leaves in poisoned liquids, and in the contents of a stomach, may be of importance in evidence. The appearance and smell of the leaves, either when bruised or when rubbed with a solution of potash, will greatly aid a medical witness in forming a judgment, as there are many umbelliferæ which bear a close resemblance to hemlock in the form of their leaves.

The alkaloid of conium, known as conine, resembles nicotine and ammonia in its liquidity, alkalinity, volatility, and in some of its chemical properties. It is a liquid of oily consistency, usually of a pale yellow colour, but is colourless when freshly prepared, powerfully alkaline, and has, when its vapour is diluted, a smell resembling that of mice, and an acrid, bitter taste. It gives a volatile greasy stain to paper, and burns with a yellow flame and thick smoke. 1. It is scarcely coloured or affected by nitric, sulphuric, or hydrochloric acid; the last-mentioned acid produces with it dense white fumes of hydrochlorate of conine, and on heating the mixture, this salt remains in prismatic crystals. 2. It dissolves in one hundred parts of water. 3. It is soluble in alcohol and ether, and this last-mentioned liquid removes it from its aqueous solution, and leaves it in oily globules on evaporation. 4. It gives a white precipitate with corrosive sublimate. 5. It gives a yellow precipitate with phospho-molybdic acid. 6. A solution of iodine in potassium iodide gives a reddish-brown precipitate. 7. It gives a yellow crystalline precipitate with auric chloride, but no precipitate with platinic chloride. 8. Tannic acid gives it a dingy white precipitate. 9. Gallic acid gives no precipitate, but slowly acquires a yellowish colour. If conine be warmed with potassium bichromate and dilute sulphuric acid, butyric acid is produced, which may be recognised by its characteristic odour (Luff). If conine be dropped into a solution of alloxan, the latter is coloured an intense reddish-purple after a few minutes. On standing, white needle-shaped crystals separate out. These, if collected and dissolved in cold caustic potash solution, produce a bluish-purple colour, and emit a strong odour of the conine (Luff). Its odour and insolubility in water, as well as several of the characters above mentioned, serve to distinguish it from nicotine and ammonia, but it may be readily separated from ammonia by potassio-mercuric iodide, which precipitates it even more completely than tannic acid. In reference to its presence in *organic mixtures*, it may be detected by its peculiar odour, or by distilling the liquid with a solution of potash, and examining the distillate extracted from organic mixture. It may be extracted by the method detailed on p. 352.

The reactions produced by tests on small quantities must be confirmed by evidence of the action of the poison on the body from the symptoms. As in reference to strychnine, veratrine, and other alkaloids, an incautious operator may readily come to the conclusion that he has found "traces," and ascribe death to the poison. The following case occurred in Germany a few years since:—

> "A man died two hours and a half after going to bed, and it was alleged that his wife had poisoned him. The persons commissioned to make the analysis deposed that they had found traces of conine in the stomach, intestines, and kidneys, and they came to the conclusion that the man had died from the effects of hemlock, which implicated his wife in a charge of murder. Some doubt appears to have arisen in the minds of the authorities on this point, and they submitted three questions for the consideration of a Medical College. 1. Is there any reason to doubt whether conine has really been found in the body of deceased? 2. If existing in the body, may it have been spontaneously produced, or does it show administration from without? Does its detection in the body incontestably prove that the deceased died from poisoning by conia or hemlock? 3. Is it improbable that deceased poisoned himself with hemlock? The college decided that there was not sufficient evidence to show that death had been caused by hemlock. The matter was then referred to Mitscherlich and Casper, and they found that the chemical

processes pursued failed to detect conine in the body—that there was nothing to indicate that deceased had taken hemlock in any form, and that the state of the windpipe sufficiently accounted for the sudden death of deceased. He had eaten and drunk freely, had vomited after going to bed; a portion of the food had entered the trachea and he had been suffocated" (see Casper's *Vierteljahrsschr.*, 1859, p. 194).

POISONING BY CROTON TIGLIUM (CROTON OIL).

Source and Method of Occurrence.—This is an oil extracted from the seeds of the *Croton tiglium.* The seeds, which are sometimes called *Purging nuts*, resemble castor seeds in size and shape. They have a dark brown or blackish colour, and are marked by longitudinal lines, and have no smell. Their taste is at first mild and oleaginous, afterwards acrid and burning. When heated they evolve an acrid vapour. As the cases below show, poisoning by croton oil is almost invariably due to accident, though it has been used in cases in which a criminal charge has been raised.

Toxicity and Fatal Dose.—Croton oil is a powerful drastic purgative, producing, in a large dose, severe purging, collapse, and death. Its official dose is from half to one or two minims.

In man, a dose of from fifteen to twenty drops of the *pure* oil might give rise to excessive purging, and cause death by exhaustion. The cases recorded of its fatal operation are few, and do not enable us to solve this question from observed facts. According to Landsberg (Christison's "Dispensatory"), thirty drops of the oil have killed a dog; and Christison states that he has known four grains of the oil to produce an alarming degree of purging. It is frequently mixed with castor-oil and other substances, and the presence of these must of course influence the dose required to act fatally.

The smallest recorded fatal dose seems to be the following:—A child, æt. thirteen months, died in six hours from a small dose given by mistake. The croton oil was mixed with soap liniment, and the quantity taken was supposed to be **less than three minims** of the oil (*Med. Times and Gaz.*, 1870, 2, p. 466).

Duration.—Croton oil is used medicinally when a rapid and powerful effect is required, and symptoms commonly set in within half an hour. Four or five hours seems to be approximately the time at which a fatal result ensues, and if this be due entirely to local effects it is a period reasonably to be expected.

Symptoms.—These are directly exhibited by the alimentary canal, as might be expected from the medicinal use. A case occurred in Paris, in 1839, in which a man swallowed by mistake two drachms and a half of croton oil. In three-quarters of an hour the surface was cold and clammy, the pulse imperceptible, the breathing difficult, and the extremities and face were as blue as in the collapsed stage of cholera. In an hour and a half purging set in; the stools were passed involuntarily, and the abdomen was very sensitive to the touch. The patient complained of a burning pain in the course of the gullet. He died in four hours after swallowing the poison. There was no marked change in the mucous membrane of the stomach ("Ann. d'Hyg.," 1871, 1, 409). For another fatal case, see *Pharm. Jour.*, February, 1863, p. 379. In one case a druggist swallowed, by mistake for cod-liver oil, half an ounce of croton oil. He felt a burning sensation in the throat and stomach, soon followed by vomiting and copious purging, with symptoms of collapse. He did not recover until after a fortnight. An aged woman died from the effects of an embrocation containing croton oil with other drugs. A teaspoonful was incautiously given to her: she immediately complained of a hot burning sensation in her throat. She died in convulsions in three days (*Med. Gaz.*, vol. 43, p. 41). A girl, æt. 19, took by mistake a teaspoonful of a liniment consisting of equal parts of croton and olive oils. In about half an hour she was seen by Brydon, and she then complained of an intense burning sensation in the throat and gullet; but there was no pain in the stomach. Her pulse was 84. Vomiting came on in a severe form, and this was promoted by a zinc emetic and warm water. After the vomiting had continued for a quarter of an hour, she complained of a severe pain in the stomach. Purging was not a prominent symptom. In a day or two she recovered (*Edin. Med. Jour.*, August, 1861, p. 134). In another case, a little girl, six years old, took by mistake about fifty-five drops of croton oil. There was vomiting, with some purging and feverishness for three or four days, but the patient recovered (*Lancet*, 1870, 1, p. 553). In these cases it is not improbable that the oil may have been adulterated.

Treatment.—Must be carried out on general principles (*vide* pp. 334 *et seq.*).

Post-mortem Appearances.—Signs of irritation may be met with in the alimentary canal, but nothing characteristic of croton oil.

Cases.—A case was tried at Liverpool (*R.* v. *Massey and Ferrand*), in which the prisoners were charged with having caused the death of a man by placing in food, of which he and others had partaken, two drachms of powdered jalap, and from two to six drops of croton oil. Several persons, including the deceased, suffered from vomiting and purging; but they recovered, and the deceased himself so far recovered as to be able to go about as usual. He was subsequently attacked with inflammation and ulceration of the bowels, from which he died. The prisoners were acquitted, as the medical evidence at the trial failed to make out the connection of this subsequent illness with the jalap and croton oil which had been put into the food.

Poisoning by Curare.

Source and Method of Occurrence.—Curare is the active principle obtained from species of strychnos, cocculus, and other plants growing in South America and elsewhere. In the places where these plants grow it has long been known as one form of arrow poison, killing with only a small wound. In England it is almost confined to laboratory experimental work, though a hypodermic injection of it has been suggested for tetanus, hydrophobia, strychnine poisoning, etc. *Vide* also works on "Physiology," where it is used experimentally.

Cases of poisoning by it are very rare; the editor can only find one recorded case, this was suicidal.

Toxicity and Fatal Dose.—It is said to be practically innocuous when swallowed (like snake venom), requiring to be injected into the blood without going through the stomach. Under these circumstances it acts, like conine, almost entirely on peripheral nerves, paralysing them. Its dose is said to be one-twentieth to one-half of a grain

("Extra Pharm."); probably three-quarters to one grain would prove fatal.

Symptoms.—Increasing paralysis with the ordinary effects on circulation and respiration are the symptoms to be expected.

Treatment.—Stimulants and perhaps hypodermics of strychnine should be tried with artificial respiration.

Analysis.—In most chemical tests it closely resembles strychnine, but sulphuric acid alone imparts a red colour to solutions of curare, while it has no effect on strychnine without the addition of bichromate of potash ("Extra Pharm."). The active principle of curare is an alkaloid curarine. With strong nitric acid curarine gives a deep red or purple colour. With concentrated sulphuric acid it gives a lasting deep blue or violet colour. Curarine can be distinguished from strychnine by the colour that it gives with nitric acid or with sulphuric acid, and also by the fact that potassium bichromate produces an amorphous precipitate of curarine chromate, whereas strychnine chromate is a crystalline precipitate (Luff).

Case.—An inquest was held at Rickmansworth on a man who had been in an inebriate home for the cocaine habit, and had given himself an injection of curare instead of (? intentionally, there was evidence suggesting suicide) morphia.

POISONING BY CYTISUS LABURNUM.

Source and Method of Occurrence.—The common laburnum, a species of cytisus, though not indigenous in England, is so frequently grown in gardens and shrubberies, and has such showy flowers and fruit, that it not infrequently gives rise to cases of poisoning in children, who accidentally eat the seeds or flowers; it has very rarely given rise to a criminal charge, the following very old case is, however, one:—

> A case of poisoning by the *bark* was the subject of a trial at Inverness (*Edin. Med. and Surg. Jour.*, October, 1843, p. 303). A youth with the intention of merely producing vomiting in one of his fellow-servants, a young woman, put some dry laburnum-bark into the broth which was being prepared for their dinner. The cook, who remarked a "strong peculiar taste" in the broth, soon became very ill, and in five minutes was attacked with violent vomiting. The account of the symptoms is imperfect, for the cause of them was not even suspected until six months afterwards. The vomiting continued thirty-six hours, was accompanied by shivering, pain in the abdomen, especially in the stomach, great feebleness, and severe purging. These symptoms continued, more or less, for a period of eight months; and the woman fell off in flesh and strength. At this time she was seen by a physician, who had been called on to investigate the case. She was then suffering from gastro-intestinal irritation, vomiting after food, pain in the abdomen increased by pressure, purging, tenesmus and bloody evacuations, with other serious symptoms. The medical opinion was that she was then in a highly dangerous state. The woman eventually recovered. There was no doubt, from the investigation made by Ross and Christison, that her protracted illness was really due to the noxious effects of laburnum-bark.

[The editor leaves this case, but he thinks the evidence very inconclusive.]

Cytisine is said to be the poison contained in an insect powder which is known by the name of Australian or Persian insect powder.

Toxicity and Fatal Dose.—The toxicity of the laburnum tree (chiefly bark and seeds) depends upon the presence in it of an alkaloid cytisine which seems to be the same as ulexin, the alkaloid present in the common furze (the prickly nature of this plant prevents accidents).

Three or four of the seeds seem to be capable of giving rise to very alarming symptoms, but the minimal fatal dose is quite undetermined.

Duration.—In the reported cases the symptoms appeared after varying intervals of an hour or more, and they pass off somewhat slowly.

Symptoms.—Pain in the stomach, nausea, vomiting, depression, and mild collapse are the principal symptoms, as the following cases well illustrate.

A girl, æt. 18, idly and unthinkingly, put a small portion of a laburnum-branch into her mouth, carrying it for some hours, and chewing it. It was described as of the thickness of the little finger, and two or three inches long. There were some yellow flowers with it, but she was not aware that she had swallowed any. In about half an hour she felt unwell, but she was not seen by a medical man until the day following. The symptoms then were great pain in the stomach, nausea and retching, but no vomiting; pulse 100, tongue white, great thirst, anxiety and pallor of countenance, dilated pupils, sense of fainting even while lying down, and great exhaustion.

There was no purging. Under treatment these symptoms disappeared, and the girl recovered in about a fortnight (*Lancet*, 1870, 2, p. 182).

Traill has described two cases, and Rake communicated to the author a case of poisoning by the pods and seeds.

Two children, the one aged two and the other three years, had been playing together, and on returning home they appeared unwell, and soon afterwards vomited. They had been seen with laburnum-pods in their hands, and some seeds with portions of the pods were mixed with the vomited matter. Both children were pale and exhausted, with a slow and somewhat feeble pulse. The pupils were natural. An emetic was given, but no more seeds were ejected; the pulse increased in volume and frequency, and the next day the children had recovered their usual health. Twelve children, at Otley, were attacked with rigidity of the limbs and other symptoms of poisoning, in consequence of having swallowed laburnum-seeds. They recovered under the use of emetics (*Lancet*, 1856, 2, p. 497).

Two boys swallowed a quantity of laburnum-seeds in a cake. In about three-quarters of an hour one was seized with vomiting and purging, weak and frequent pulse, severe rigors, muscular twitchings in the face and neck, and great epigastric pain. The pupils were dilated, but there was no headache. Many seeds were vomited. There was a great disposition to sleep, and coldness of the skin. Under treatment they recovered (*Pharm. Jour.*, October, 1862, p. 185). A girl, æt. 9, died in consequence of having eaten a few of the seeds. A boy, æt. 4, ate about ten of the seeds. In half an hour he began to vomit, the vomited matter consisting of food and thick mucus. He afterwards became drowsy, and was seized with convulsions, shaking violently, and drawing up his limbs at intervals. Although drowsy, he was easily roused, but soon dozed off again. Both pupils were widely dilated, pulse eighty-five and small, surface especially of the limbs cold. He fell into a calm sleep, and the next day he was well (*Lancet*, 1871, 2, p. 396).

Treatment.—Emetics and the stomach pump must be used to empty the stomach, and then the depression and collapse must be treated on general principles.

Post-mortem Appearances.—Nothing characteristic unless portions of the plant are obtainable to examine with the eye and lens.

Analysis.—The modified Stas operation d
be utilised for the extraction of alkaloids, but c
from an aqueous solution by chloroform. Rad
amyl alcohol for this purpose, but Moer and Pl
alkaloid is much more soluble in chloroform tl

Cytisine dissolves in concentrated sulphuric
change of colour; on warming, the mixture
a little cytisine dissolved in a few drops of
acid in the cold a drop of nitric acid is added,
duced. If to a mixture of cytisine and sulphu
potassium dichromate is added, a yellow col
changes to dirty-brown and finally to green.
ferric salt cytisine yields a red colour, which di
of a few drops of a solution of peroxide of hy
warming a blue colour is produced. This
according to Moer and Plugge it will indica
mgrm. of the alkaloid (Mann). The *seeds*
shaped, and slightly hooked at the hilum.
become dark-coloured, and present irregula
surface. They have no markings, and are th
from most other poisonous seeds. They ar
Datura stramonium.

Cases.—The following six cases of poisoning by *Cy*
by St. Johnston. W. G., aged ten years, was brought
20th, 1891, and stated that he, together with several
about two hours after dinner, had found during a wa
on it, which they thought to be small beans. Several
be the seed-cases of the *Cytisus laburnum*. W. G. ha
pods (that is, eight or ten seeds). Five or ten minu
sweat, but soon became cold and shivering, and a little
ing. He vomited three times, and there were portio
ejected. He was then purged once. About an hour l
and he was cold and shivering, skin pale, and pulse s
in a state of general collapse. His pupils were dilated,
giddy, but suffered no pain. After his stomach had b
brandy was administered. He, however, showed littl
the next hour or so, when an enema of hot strong coffe
wrapped in blankets, and hot bottles applied. The col
off, and the patient was able to leave the hospital in a
bad symptoms since. P. H., aged eleven years, was l
the previous case, and in a similar condition. He had
four pods, and some time after was seized with vomiti
giddiness, and scarcely perceptible pulse; his pupils
child appeared to be in a critical condition, and was ac
to bed, and treated as in the previous case. S. H.,

had given her, but as she showed no symptoms two hours afterwards she re
no treatment (*B. M. J.*, 1891, 2, p. 695).

The *flowers* of this plant are highly noxious. A child, between three an
years of age, ate twelve laburnum-flowers, and in about fifteen minutes i
plained of sickness and severe pain in the stomach. The child vomited a qu
of mucus mixed with the yellow petals of the laburnum. An emetic was
this cleared the stomach, and the child recovered. There was no p
(Guy's Hosp. Rep., 1850, p. 219).

For cases in which five children were poisoned by laburnum-seeds, *vide B.*
2, 1895, p. 778, and three non-fatal, but very serious, cases are reported
Lancet, 2, 1901, p. 491.

In 1882, two fatal cases of poisoning occurred by some undetermined p
of the laburnum-tree (*B. M. J.*, 1882, 1, p. 199). The victims were two chi
aged respectively three and eight years. The elder child was seized with vo
and diarrhœa, headache, and prostration. In six hours the vomiting and dia
ceased. She then made noises in her breathing, and continued in much the
state till her death, fourteen hours after she was attacked. Next day the y
child became tired and sleepy, vomited, and complained of headache. She v
freely, and passed two motions. Five and a half hours after the commen
of the symptoms she was convulsed, and the convulsions continued till her
eight hours from the commencement of the attack. On post-mortem exami
being made, some signs of irritation of the stomach and intestines were ob
in each case.

The contents of the stomachs of both children were examined by the e
by the microscope, but no fragments of the structures of the laburnum wer
covered. Evidence was, however, obtained by Fairley, in both cases,
presence of cytisine, the poisonous alkaloid present in the flowers, seeds,
leaves, and all parts of the common laburnum-tree. A small portion of an al
extract made from the stomach and contents of the elder child was admini
to a mouse, which died in the course of a few hours.

Poisoning by Daphne mezereon.

The following account is from Mann ("For. Med.," 590), the e
being unable to find any other recorded cases :—

"Daphne mezereum, or mezereon, occasionally gives ris
accidental poisoning in children who pluck and eat the berries.
juice is strongly irritant, and tends to destroy mucous surfaces
which it comes in contact.

"The symptoms are illustrated by the following cases. I
(*B. M. J.*, 1887) saw a child, four years old, after it had eaten at
twelve mezereon berries. Convulsions occurred before any
symptoms; an emetic was given, and vomiting procured; three
after, the lips and tongue were swollen; the tongue, twice its na
size, was raw, and protruded beyond the lips; there was difficul
swallowing, the limbs were cold, and the pulse—one hundred and t
in the minute—was very weak; recovery took place. Dunne s

POISONING BY DATURA STRAMONIUM.

Source and Method of Occurrence.—The plant is known as thornapple. It is not a very common plant in England, but when once it has established itself as a weed in a garden it is difficult to eradicate it again. The flowers are attractive, but nothing else is.

All parts of this plant are poisonous; but the *seeds* and *fruit* are considered to be the most noxious.

The plant is not now official, but stramonium cigarettes are smoked for asthma. In the return of the Registrar-General for April, 1856, there is the record of one death from this cause.

One of the methods of poisoning adopted by the Hindoos, not so much with the intention of destroying life as of facilitating the perpetration of robbery, consists in administering to persons either the powdered seeds, or a strong decoction of them, in curry, or in some other highly flavoured article of food. Chevers has given a very complete account of the Hindoo system of poisoning by *dhatoora* ("Med. Jur. for India," 1856, pp. 121, 549, 591. See also *B. M. J.*, 1892, 2, p. 641). It appears that the *Datura fastuosa, alba,* and *stramonium* are the principal sources of the poison in India. The Thugs employ this poison with the object of rendering their intended victims helpless. Delirium and insensibility soon follow, and sometimes death is the result; but no suspicion of the real cause appears to be excited. *Vide* Appendix on "Indian Poisons," also cases below. A similar method is possibly used by thieves in this country for hocussing their victims.

Toxicity and Fatal Dose.—The toxicity of the active principle, a mixture of atropine and hyoscyamine, is extremely great, and as the plant contains, approximately, one per cent. of alkaloids, it must be considered dangerous. Death may take place although the whole of the seeds are ejected. A child, æt. 2, swallowed about one hundred seeds of stramonium, weighing sixteen grains. The usual symptoms were manifested in an hour, and the child died in twenty-four hours, although twenty seeds had been ejected by vomiting and eighty by purging (*Med. Gaz.*, vol. 15, p. 194). Sufficient alkaloid to destroy life had been absorbed from the entire seeds and carried into the blood. In a case which became the subject of a trial at Osnabrück, a woman administered to her mother a decoction of the bruised *seeds* of the thornapple, of which it was supposed there were about 125. She very soon became delirious, threw her arms about, and spoke incoherently; she died in seven hours (Henke, *Zeitsch. der S. A.*, 1837, 1, H.) The seeds are highly poisonous, inasmuch as they contain a larger proportion of alkaloids than other parts of the plant.

Brown, of Lahore, states that out of 92 cases of "hocussing" no less than 21 were known to have proved fatal from the drug, and probably many more are really fatal from it, only death is ascribed t coincident violence.

There is no definite record of the minimum fatal dose, but i probably corresponds very closely with that of belladonna, at any rat as regards the active principle, the two being practically identical i this respect.

Duration.—The symptoms commonly come on in about te minutes after the poison has been taken; they may be delayed from half to an hour, depending on the skill of the administrator. In accidental cases the shorter limit is that usually observed. In fatal cases death usually occurs within three or four hours; in non-fatal cases recovery takes a day or two, the effect on the pupils being the last to disappear.

Symptoms.—The drug has a bitter taste, which it generally imparts to the food with which it is mixed; this is sometimes recognised when it is eaten. Following the taste there soon appear symptoms closely resembling those of belladonna poisoning. There is at first a dryness in the throat, attended with a feeling of faintness, headache, and giddiness, and the person has difficulty in walking straight, and appears as if intoxicated, while at the same time he is very restless. The pupils are dilated, and he will sometimes complain of indistinctness of vision, or drowsiness, and he almost always falls asleep. The sleep may either increase to complete insensibility with dilated pupils, a flushed face, and muttering delirium, or the patient may awake and then become delirious. The delirium is characterised by great restlessness, the person affected frequently moving about, and there is a tendency to strip naked and to pick at various objects. The pulse is generally slow, and there is great thirst. After a time the patient becomes again insensible, and is greatly exhausted; sometimes convulsions occur, with low muttering delirium, and at length he dies. If, as it more frequently happens, he recovers, the insensibility persists for a day or more, and the patient remains occasionally in an idiotic state, able to speak, but not to understand for some time longer, and he has no recollection of what has occurred after the poisonous meal. Sometimes vomiting is an early symptom, although this is rare ("Poisons in the Punjab," 1863, p. 57).

As it is administered by skilled professional poisoners in India, it causes a profound lethargy resembling coma. Chevers notices the occasional early occurrence of insensibility. A man drank two mouthfuls of a poisoned liquid, complained of a bitter taste, and fell down insensible within forty yards of the spot where he had drunk the liquid, and did not recover his senses until the third day after (*op. cit.*, p. 137). In these cases, probably the seeds are given in a large dose, either in solution or in very fine powder.

More commonly the delirium appears rapidly, the victim talks incoherently, laughs wildly, moves about as if to avoid spectra, and picks or catches incessantly at real or imaginary objects. He appears as if drawing out imaginary threads from the ends of his fingers, and his antics are of the most varied and ludicrous kind. The pupils are invariably dilated, and the spectra are illusions depending on disordered vision. Distant objects appear near to him, and near objects as if highly magnified; he will attempt to grasp a distant object as if it were close at hand, and will start back on a person approaching, as if he thought the person was quite near to him. In the second stage of poisoning, there is either great drowsiness or complete stupor, sometimes passing into utter insensibility, with stertorous breathing. The third stage of final delirium is similar to the first (*op. cit.*, p. 593). The dilatation of the pupil, with the peculiar train of symptoms above described, would distinguish this state from ordinary intoxication.

The bitter taste of the liquid might excite suspicion; but if the person is already partially intoxicated he might easily overlook the taste of his liquor. For some additional information respecting the employment of datura by the professional poisoners of India, see Irving's "Cases of Food-Poisoning," etc., 1864.

Treatment.—Cases must be treated on exactly the same lines as cases of belladonna poisoning (*q.v.*, p. 687).

Post-mortem Appearances.—There is, beyond finding bits of the plant in the stomach or intestines, absolutely nothing to indicate death by poison even, not to mention death by a particular poison. Irving describes the appearances met with in the body of one of the professional Indian poisoners, Bassawur Singh, who, in order to lull suspicion, partook of the poisoned food himself. His intended victims became insensible; he robbed them and left them to their fate. After a time they recovered their senses, and gave information at the police-station. The poisoner was found under a tree, about a mile from the place, quite insensible. Remedies were unsuccessfully used, and he died shortly after being apprehended. On his person was found all the stolen property, besides a quantity of datura seeds. The following were the post-mortem appearances:—The pupils were widely dilated; the body was covered with dust, as if it had been rolled on the ground. The fingers of both hands were firmly clenched. There was great venous congestion of the brain and membranes, and slight effusion of bloody serum under the membranes, chiefly on the right hemisphere. About an ounce of dark fluid blood was found at the base of the skull. The ventricles contained a considerable quantity of serum. The choroid plexus was unusually full of blood. In the stomach there was a quantity of food, partly digested, in which were found seeds of datura as well as seeds of the *Solanum melongena*, which in form they somewhat resembled ("Cases of Food-Poisoning," etc., 1864; "Ind. Annals of Med. Sci.," No. 17).

Analysis.—The *seeds* of stramonium, from which accidents have most frequently occurred, are flattened, kidney-shaped, but half oval, rough, and of a dark-brown or black colour. The seeds are liable to be mistaken for those of capsicum. Brown thus describes the difference:—"The datura seeds present dots on their exterior, which on a microscopical examination are seen to be composed of convoluted ridges surrounding spaces. On the capsicum seed these convoluted ridges run nearly parallel to each other, and are joined at right angles by shorter ridges so that most of the spaces are of an oblong form, and are as lines curving round the seed: but in datura, the ridges are more convoluted and irregular, joining at acute angles and circumscribing irregular spaces" ("Poisons of the Punjab," 1863, p. 67). Of the dry *Datura stramonium*, about eight seeds weigh one grain. The seeds of the *Datura fastuosa* are very similar in size and general appearance. The seeds of *Datura alba* are larger, flatter, and much lighter-coloured, but have similar microscopical characters. These are the seeds which are chiefly used by the Thugs and the poisoning robbers of India.

The *leaves* of the common *Datura stramonium* are well characterised by their peculiar shape. In the full-grown plant the leaves retain the same characters, but are much larger.

Daturine.—The poisonous properties of thornapple were formerly ascribed to the presence of an alkaloid, *daturine*, which forms about one per cent. of the dried vegetable. According to Ladenberg, it is a mere mixture of atropine and hyoscyamine. The alkaloids may be extracted from organic materials by the process described on p. 352. The so-called alkaloid crystallises in long colourless prisms or needles; it has a bitter taste, somewhat acrid, and slightly resembling that of tobacco. It is poisonous. The eighth of a grain killed a sparrow in three hours. When placed on the eye, or introduced subcutaneously into an animal, it is observed, like atropine, to cause dilatation of the pupil. When heated in a tube it is decomposed, and ammonia is evolved, as with other alkaloids. It is soluble in water, and the solution has an alkaline reaction. It is precipitated by tannic acid and by potassio-mercuric iodide. Nitric and hydrochloric acids dissolve it, without producing any change of colour. Sulphuric acid produces a pale rose-red colour with the crystals, which becomes paler when the acid mixture is diluted with water.

Cases.—The following show by the uniformity of symptoms the likeness (probable identity) of stramonium to belladonna:—

On January 9th, at noon, Mrs. H., aged fifty-three, took a teaspoonful of an anti-asthmatical powder in mistake for liquorice powder. At 12.45 p.m., when sitting down to dinner, she could not understand a dry feeling in her mouth, which sipping water did not affect in the least; at the same time her sight became blurred, and she experienced a peculiar sensation of swelling in her eyes; lifting the glass to moisten her lips she exclaimed at the weight of it, and feeling herself getting worse she told her husband to go for the doctor, and from this time remembered nothing till about 6 or 7 p.m. When I saw her at 2 p.m. her condition bore a remarkable resemblance to a case of *delirium tremens;* her face, however, which was markedly pale, was not expressive of suspicion nor anxiety, nor was there any clammy perspiration, the skin being perfectly dry. Her eyes were bright and staring, the pupils dilated but not excessively, and absolutely insensible to light. The flow of ideas was very rapid, and her speech so fast that only at times could any sense be made of what she said. Mirthful delirium and hallucinations were very prominent, but illusions and delusions were markedly absent. Although she often attempted to rise she seemed unable to do so from inco-ordination of the lower extremities. Sensation, however, was perfect. The power of swallowing at first seemed absent, but if she was prevented from returning what was placed in her mouth she swallowed it. Breathing was quiet, but the pulse was very rapid, thready and compressible. After using the stomach pump freely, nitrite of amyl and digitalin (hypodermic) were administered, and shortly afterwards pilocarpin (one-third of a grain). Recovery after the use of the latter was remarkably rapid (*B. M. J.*, 1, 1898, p. 1071).

Turner (*Amer. Jour. Med. Sci.*, April, 1864, p. 552) describes five cases of poisoning by these seeds in children under ten years of age. They had eaten them in the scarcely ripe state, when they are not very bitter. In one hour and a half two of the children were found to be fully under the influence of the poison. They were lying on their backs, the eyes bright, and the pupils widely dilated and insensible to light; the conjunctivæ were injected, the face deeply suffused and of a dark crimson colour; there was difficulty of breathing, inability to articulate, and a state of complete insensibility, broken occasionally by a paroxysm, during which they would utter some indistinct sounds and throw their hands about, as if trying to ward off some threatening evil. Then they fell into a comatose state, but were easily roused into a state of violent excitement; they grasped at imaginary objects; there was picking at the bed-clothes, with paroxysms of excessive laughter. They had no proper control over their limbs, walked with a staggering gait, and fell to the ground as if intoxicated, or in a state of complete exhaustion. They recovered under treatment in about twenty-four hours (see also other cases in the same journal, January 7th, 1862, p. 54).

A girl, æt. 5, ate about half a dozen stramonium seeds, together with some of the pulpy matrix of the fruit. Symptoms came on within twenty minutes, beginning with dryness and burning of the throat, thirst, inability to swallow, nausea and retching, but no vomiting, pain in the stomach, flushed face, giddiness, and singing in the ears. Twitchings of the muscles of the forearm were next observed, and delirium set in. When seen an hour and a half after eating the seeds, the girl was lying on her back, delirious, apparently unconscious, and in convulsions. She caught at imaginary objects in the air. The eyes were bright and glistening, the conjunctivæ red and injected, and the pupils widely dilated. The delirium was of a busy kind—fits of laughter alternating with fits of crying and horror. The convulsions were general. The skin was hot, dry, and of a deep scarlet hue; the temperature normal; the pulse small and rapid; the respiration interrupted, but not rapid. She recovered. From six ounces of the urine voided five hours after the seeds were eaten, a substance was obtained by Stas's process which dilated the pupil when applied to the eye of a man; and this dilatation lasted for some hours (Canada *Lancet*, vol. 14, p. 161).

POISONING BY DIGITALIS PURPUREA.

Source and Method of Occurrence.—The purple foxglove, Digitalis purpurea, is a well-known common wild flower in England. It belongs to the Natural Order Scrophulariaceæ. All parts of the plant are poisonous in anything like large quantities, but it is the leaves that are used for medicinal purposes.

Owing to its value as a medicine digitalis has been more closely studied than any other of our English plants. The result has been to disclose several bodies of an alkaloidal nature, including a glucoside digitalin and three other (? distinct) principles named digitoxin, digitonin, digitalin.

The leaves themselves, one-half to two grains, the infusion, two to four drachms, and the tincture, five to fifteen minims, are the official preparations of the drug and their respective doses.

Digitalis poisoning is not common, except in the shape of overdoses given medicinally but injudiciously, which have produced unpleasant symptoms, and probably hastened the end in many cases of heart disease. Sir Thos. Stevenson has seen a patient under the influence of digitalis die very suddenly on being raised by the nurse from the recumbent to the sitting posture.

In October, 1826 (at the C. C. C.), a quack was indicted for the manslaughter of a boy who died twenty-two hours after taking six ounces of a strong decoction of the leaves.

In 1864, a man was executed in Paris for murder by digitalin.

Toxicity and Fatal Dose.—Thirty-eight grains of the leaves and nine drachms of the tincture have proved fatal (Luff), so that the plant and its official preparations cannot be considered as very fatal poisons, but digitalin operates powerfully on man and animals in very small doses, and must be regarded as a deadly poison. One-sixteenth of a grain, which is considered to be equal to eight grains of the well-prepared powder of the dried leaves, is sufficient to cause symptoms of poisoning. Doses of from one-eleventh to one thirty-second part of a grain have lowered the pulse and caused nausea, vomiting, griping, purging, and an increased secretion of urine (Pereira, "Mat. Med."). Doses of from one-quarter to one-half of a grain would probably prove fatal to life. Homolle found in experiments on himself that small doses of digitalin taken at intervals lowered the pulse to about one-fourth or one-fifth of the normal standard: thus in himself it fell to seventeen in

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one minute, which represents a fourth of the normal pulsations. In doses of from one-fifteenth to one-thirtieth of a grain in twenty-four hours, digitalin slackened the circulation. In doses above one-fifteenth of a grain, it produced on adults emetic and purgative effects, sometimes suddenly, at others slowly and gradually. In doses of from one to two grains, unless speedily thrown off by vomiting, it killed dogs in a few hours (Orfila, "Toxicologie," vol. 2, p. 350; see also a paper by Fagge and Stevenson, Guy's Hosp. Rep., 1866, p. 37).

All the "extractives" of digitalis are found to be extremely active in very small doses.

It is found that digitalis is more rapidly absorbed from the stomach than excreted by the kidneys, and hence it has been called a cumulative poison. It deserves rather to be spoken of as a drug to be used with caution, *i.e.* the quantity of urine must be measured frequently while the patient is taking digitalis.

Symptoms.—The effects from a pharmacological point of view have been very carefully studied (Lauder Brunton, "Pharmacology"), and it has been found to have three principal actions: (1) it is an irritant to the stomach; (2) it slows and makes more forcible the heart-beat—eventually by exhaustion quickens and enfeebles it; (3) it increases the tone of the arterioles and so increases blood pressure, eventually by exhaustion diminishing both tone and pressure.

A young man swallowed a strong *decoction* of foxglove by mistake for purgative medicine. He was soon seized with vomiting, pain in the abdomen, and purging. In the afternoon he fell asleep. At midnight he awoke, was attacked with violent vomiting, colic, convulsions, and the pupils were dilated and insensible to light; his pulse was slow and irregular. He died twenty-two hours after taking the poison (Wibmer, *op. cit.*, "Digitalis"). A few grains of the powdered leaves have been known to produce giddiness, languor, dimness of sight and other nervous symptoms. A drachm, however, has been taken without causing death; but in this instance it produced the most violent vomiting. A woman made an infusion of digitalis, and swallowed it by mistake. The symptoms which followed were vomiting, paleness of the face, coldness of the skin, prostration, muscular feebleness, a persistent feeling of drunkenness, headache, giddiness, confusion of sight, dilatation of the pupils, and loss of sensibility. The vomiting was constant, and aggravated by anything that was taken. There was constipation of the bowels, with suppression of urine. There was thirst, with pains in the abdomen increased by pressure, and great restlessness at night. At first the pulse was fifty-two. On the fourth day it was forty-one to forty-two. On the fifth day it was fifty-eight, less irregular, and the symptoms had abated. During the night she got up, and on returning to her bed suddenly fainted, and died. A person labouring under symptoms of poisoning by digitalis should always be kept in the recumbent posture (*Edin. Month. Jour.*, 1864, p. 169). In the clinical cases the symptoms are much the same, but the heart gets very rapid and irregular when the dose is a deleterious one.

Treatment.—The stomach should be emptied if parts of the plant have been taken; beyond this, but little can be done. In the clinical cases the main thing is the cessation of administration. Digitalis is a good antidote to aconite poisoning, but in the converse proposition it has to be remembered that the rapid feeble pulse of digitalis poisoning is due to exhaustion of the nerve centres, and therefore not altogether likely to be benefited by aconite, which in itself will soon exhaust the same centres. In the *B. M. J.*, 2, 1899, p. 1264, is an account of experiments by J. J. Taylor and C. R. Marshall on the treatment of digitalis poisoning; they finally conclude that it must be symptomatic, as there is no available antidote.

Post-mortem Appearances.—Beyond bits of the plant there is nothing to be expected, unless it be slight inflammation of the stomach owing to the irritant action of the drug.

Analysis.—In reference to the infusion or tincture, except there be sufficient to allow of the separation of digitalin, there is no chemical process known by which the poison may be recognised. If any fragments of leaves or seeds are found in the contents of the stomach or in food, they may be identified by the aid of the microscope.

It is stated that digitalin constitutes only one per cent. of the dried leaves. In reference to the *seeds* of the foxglove, they are of a reddish-brown colour, remarkably small, oblong and somewhat angular in shape. They have peculiar markings. By the aid of the microscope they may be easily distinguished from the seeds of hyoscyamus, datura, belladonna, and most other poisonous plants.

The toxicological properties of digitalin, and other extractives, have been investigated by many pharmacologists (*vide B. M. J.*, Epit., 1, 1900, p. 52). The commercial article has a pale fawn colour. The French and German varieties are not identical. Nativelle has obtained it by the aid of boiling 90 per cent. alcohol in fine white and shining needles (*Pharm. Jour.*, 1872, April 27th, p. 865). Alcohol is its best solvent. Boiling water takes it up in small quantity, acquiring a tea-like odour: its solutions are intensely bitter. It is a mixture of neutral vegetable principles, having neither alkaline nor acid reaction. In solution it is precipitated by tannic acid, but not by potassio-mercuric iodide; and by this property it may be distinguished from the alkaloids. When heated in a tube it melts and is decomposed, evolving an acid, and not an ammoniacal vapour. Strong nitric acid dissolves it, and gives to it a deep orange-red colour. This acid solution speedily acquires a pale yellow colour on standing. Iodic acid is unchanged by it. Hydrochloric acid dissolves it, and when gently heated the solution becomes green. Strong sulphuric acid gives to it a brown colour, and after exposure for some time or by a gentle heat this colour changes to a purplish black. If the sulphuric acid solution is diluted, the liquid immediately assumes a dingy green colour. Diluted sulphuric acid heated with the powder gives a reddish-black colour. Grandeau has suggested another test. If the digitalin has been previously dissolved and the liquid evaporated, sulphuric acid imparts a rose colour to small quantities, or a reddish-brown or even brown colour when the digitalin is in rather large quantity. If the digitalin, moistened with sulphuric acid, is exposed to the vapour of bromine, it immediately assumes a violet colour. This peculiar colour is observed even with the faintest trace of digitalin, and it is regarded by him as characteristic. Seventeen of the alkaloids and principles thus tested did not acquire a violet colour (*Chem. News*, July 16th, 1864, p. 26). According to

Grandeau, digitalin readily admits of separation by dialysis from organic liquids. Tardieu and Roussin and Sir Thomas Stevenson have not found this method so successful in practice as these experiments on pure digitalin would appear to indicate ("Ann. d'Hyg.," 1864, p. 80). According to Brurmer ("Deut. Chem. Ges. Ber.," 1873, p. 96) and Almquist ("Arch. Pharm.," [3] 5, p. 515), digitalin, when in a separate state, may be detected by the red colour produced when its solution is mixed with a dilute watery solution of dried ox-bile, and then with a quantity of strong sulphuric acid sufficient to raise the temperature to 158° F. The test is inapplicable when sugar or several glucosides are present. Fagge and Sir Thomas Stevenson found the physiological test applied to a frog the best test for the presence of digitalin (Guy's Hosp. Rep., 1866, p. 37).

The aqueous extract obtained in the usual way (p. 352) from organic matter is best shaken out with chloroform, in which all the active principles of digitalis are soluble; they are not all soluble in ether nor in benzine; it is to be remembered that digitalin in *acid* solution is taken up by chloroform (Mann).

Cases.—Digitalin has acquired some notoriety by reason of the trial of Dr. De la Pommerais, at Paris, in 1864, for the murder of his mistress, a woman named Pauw. The deceased, who was about forty years of age, and in the enjoyment of good health, was suddenly seized with violent vomiting, and, after an illness of about twenty-four hours, died on November 17th, 1863. The prisoner had induced her to insure her life in various insurance offices for enormous sums of money, quite disproportioned to her circumstances. Immediately after her death he put in a claim for these large insurances. The body of the deceased was exhumed, and inspected for the first time thirteen days after death. The viscera throughout were healthy; they presented no unusual appearance, and revealed no natural cause of sudden death. The stomach and bowels, which were well preserved, bore no marks of the action of poison: and, on a chemical analysis, no poison of any kind could be detected in these organs by Tardieu and Roussin. The symptoms, during the illness, owing to there being no suspicion of poisoning, were not accurately observed. Repeated vomiting, with great depression and exhaustion, seem to have been the most prominent. Failing to detect any poison by chemistry and the microscope, the experts adopted the physiological test of administering prepared alcoholic and aqueous extracts of the stomach and intestines to animals. An attempt made to separate the active principle and remove the organic matter by dialysis, did not yield satisfactory results ("Ann. d'Hyg.," 1864, 2, 105). Seventy-five grains of the mixed extracts above mentioned were introduced subcutaneously into the thigh of a dog. The animal vomited twice; and in four hours the pulsations of the heart sank from 102 to 86; its action was irregular and intermittent, and the respiration was deep and painful. There were no narcotic symptoms; on the next day, the dog was better, and it completely recovered. Sixty grains of these extracts in water, administered to a rabbit by means of a funnel, caused death in a few minutes, probably from syncope (or asphyxia ?).

The deceased, during her fatal illness, had vomited on the floor of her room. An alcoholic extract was made of the scrapings of the floor and of the substances deposited between the planks. No mineral poison was found in it. Seventy-five grains of this extract were introduced subcutaneously into the thigh of a dog. The animal suffered from vomiting and depression of the action of the heart, and died in about twenty-two hours. There was no coma nor insensibility at any time. Thirty-one grains of the same extract diffused in water were administered to a rabbit by means of a funnel. In less than three hours after the injection the animal died, having suffered from irregular and depressed action of the heart. Sixty grains of an alcoholic extract from the scrapings of the floor, said to be free from vomited matters, had no effect upon an animal.

These two extracts of the floor had different chemical properties. The first, containing, as it was believed, a portion of the vomited matters, amounted to half an ounce. It was of a brown colour, had a rancid oily odour, and a bitter taste.

Its solution was precipitated by tannic acid; it was coloured purple-red by sulphuric, and green by hydrochloric acid. The second was coloured, had an oily aspect, but no bitterness. It was not precipitated by tannic acid, and was feebly coloured by sulphuric and hydrochloric acids; the results being different from those obtained with the first extract. It was objected to any inferences from the properties of these extracts, that deceased's room had been formerly occupied by a photographic artist; but it is expressly stated that no noxious mineral substances, such as are used in photography, were found in them. No attempt was made to procure digitalin from the extracts; the presence of this principle was a matter of inference, from the extracts produced; and the reason assigned for the extract derived from the stomach and bowels of deceased having no fatal effect upon animals, was that the quantity of the active principle left in the body at the time of death was too small.

Tardieu and Roussin deposed at the trial that the deceased had died from a vegetable poison which produced no marked change in the body, which could not be revealed by chemical analysis, but only by its noxious effects on animals. The effects,on animals were in this case similar to those caused by digitalin, and without positively affirming that the deceased woman, Pauw, had died from this poison, there was the strongest presumption that she fell a victim to it. The deceased was quite well the day before her death, and the post-mortem examination of the body proved the absence of any natural cause to account for this sudden death.

In reference to the accused, it was proved that he had in his possession a large number of poisons of a deadly kind, including digitalin; that he had at three different times purchased as much as fifty-two grains of this poison, of which much had been used, and that those quantities were inconsistent with any reasonable medical requirements. As the prisoner was a homœopathic practitioner, the purchase and actual use of such large quantities of so potent a drug were quite inexplicable on any theory consistent with his innocence. On the other hand, the case was equally against him in its moral aspects; it was clearly established that, by reason of the large insurances effected on her life, he had a strong motive in the death of the woman, that a long cessation of their intimacy had taken place by reason of his marriage with another person, that he had suddenly and without any reasonable grounds renewed his intimacy with the deceased, and the date of her fatal illness was in accordance with these visits thus renewed. In short, De la Pommerais had the motive, means, and opportunity of destroying the life of this woman by poison, and no theory consistent with his innocence could be suggested, by those who defended him, to explain satisfactorily the mass of moral and medical circumstances which were clearly proved against him. Further, he overacted his part, and by forged letters and correspondence had shown that he had fully anticipated the sudden death of the woman Pauw, and the explanations that might be required of him in order to account for this event. Apart from any questions respecting the speculative character of the medical evidence, there were circumstances proved in this case which were inconsistent with any theory of the innocence of the accused. The jury found him guilty of murder, and he was executed.

POISONING BY EPILOBIUM HIRSUTUM.

Source and Method of Occurrence.—This plant is exceedingly common, growing in damp places by the side of brooks. It has showy, attractive flowers, and is known locally as "codlings and cream." The editor is unable to find any mention of its possessing toxic properties other than the ordinary irritating effect of raw vegetable fibres on the human stomach. The following case, *B. M. J.*, 2, 1897, p. 707, seems to the editor more like the effects of a slight sunstroke than poisoning, although recorded by such an eminent authority as Prof. Thos. Oliver:—

"W. E. P., aged three years, a well-developed boy, was admitted under the care of Dr. Oliver on August 5th, 1897, in a state of complete coma, and the subject of epileptiform convulsions following each other in rapid succession. He had been only a very short time ill. His temperature on admission was 100° F. It appears that immediately previous to his illness the boy, who had been quite well, had been playing with a little friend, and that they had in their possession a bunch of plants known as the hairy willow herb, some of the flowers of which the patient had eaten. Very shortly afterwards the mother found the child unconscious and in convulsions. In this condition she brought him to the infirmary. There was no history, and no mark of any injury; no albumen was found in the urine, and there was no discharge from either ear. The abdomen was distended, the pupils contracted, and the patient was in a state of complete collapse.

"Dr. P. Davidson, to whom Dr. Oliver is indebted for the notes of the case, admitted the patient, and at once washed out the stomach, bringing away remnants of food and a pink juice, such as the flowers, which the little fellow had in his hands, gave on expression. An ounce of castor-oil and ten grains of potassium bromide were carried into the stomach by the tube, and within half an hour the fits ceased, and in about an hour the child regained consciousness. Next day, when seen by Dr. Oliver, the boy was heavy, and with difficulty roused. Some of the sleepiness was probably due to the bromide. Shortly after the bowels had been freely moved the patient became quite well."

POISONING BY ERYTHROXYLON COCA (COCAINE).

Source and Method of Occurrence.—Erythroxylon coca is the plant from the leaves of which the alkaloid cocaine is now extracted. The alkaloid has lately come to enjoy a great reputation as a local anæsthetic, and, in consequence, has been used very largely, with, in a good many cases, most disastrous results, both from acute poisoning and from the habit of taking the drug in small quantities.

The official preparations of the plant are the leaves, liquid extract, dose ½ to 1 drachm, and the alkaloid, the dose of the hydrochlorate of which is, officially, one-fifth to half a grain; there is also a 10 per cent. solution for hypodermic use, the dose of which is given as two to five minims. Lamellæ, containing one-fiftieth grain, trochisci, containing one-twentieth grain, and an ointment, containing four grains in 100, are also prepared. Many preparations of coca leaves are made, elixir extract, infusion, vinum, etc., but only the liquid extract is official.

So far as the editor is aware, no homicidal case of the use of cocaine has yet been recorded; one accidental, and three suicidal deaths, are recorded in 1901 by the Registrar-General, but this does not represent a small fraction even of the cases in which symptoms of an unpleasant kind have occurred or developed from the use of cocoaine, which seems to be as attractive, if not more so, than morphia, to people of feeble resolution.

Its use amongst dentists for local anæsthesia gives rise to a very large number of cases of poisoning every year. Happily, but few are fatal. One such, however, occurred in 1908 in the practice of an unqualified man, and gave rise to a criminal charge.

Toxicity and Fatal Dose.—About two-thirds of a grain seems to be the smallest recorded dose which has caused death (Mann), but in regard to toxicity, the power of the resistance of the human frame seems to be capable of almost indefinite increase by habit (as in the case of opium). Mann (*loc. cit.*) records the case of a man who habitually injected twenty-three grains daily beneath his skin. Sir Thos. Stevenson, in the last edition of this work, states that even one-sixth of a grain, hypodermically, may cause toxic symptoms.

According to Dr. Zantchevsky's experiments on dogs, the lethal dose for a man (calculated according to body weight) would be from twenty to forty grams, while chronic poisoning, fatal in six to fourteen weeks, would be produced by a daily injection of four grams. In acute poisoning the dogs did not present for the first few minutes after the injection anything abnormal, or they fell into a kind of stupor. Then appeared dilatation of the pupils, restlessness, extreme dyspnœa, and acceleration of the pulse; and in fifteen minutes attacks of clonic spasms, lasting for half a minute or so, and alternating with paroxysms of typical Cheyne-Stokes breathing. Later there were complete general anæsthesia, dilatation of the pupils, conjunctival congestion, lachrymation, cyanosis, loss of consciousness, incontinence of urine and fæces, stertorous breathing, tremor of the whole body, and progressive failure and retarding of the heart's action.

Duration.—Local anæsthesia is produced in a few minutes by cocaine solutions, and a similar period usually elapses before ill effects are produced by toxic doses in acute cases. As in the case of morphia, danger is not over for many hours after a large dose, in one unaccustomed to the drug.

Symptoms.—*In Acute Cases.*—These are nausea, vomiting, headache, giddiness, loss of vision, profuse perspiration, lividity, cramps in the region of the stomach, a quick irregular feeble pulse, shallow gasping respiration, convulsions, paralysis, and in some cases delirium (*vide B. M. J.*, 1888, 1, p. 151).

A man, æt. 40, injected beneath his skin half a grain of the alkaloid to remedy the after-effects of drunkenness. Twenty minutes later, he was found lying on a doorstep, pale, with dilated pupils, and the conjunctiva of the eyes insensitive. The breathing was slow and difficult, the pulse 140 in the minute. He was sensible, unable to articulate, and could not swallow, liquids being rejected from the mouth. The patient was in a serious state for some time, but recovered. This man had previously had repeated doses of five and six-tenths of a grain administered by injection every half-hour till three grains had been used, without ill effects (*B. M. J.*, 1887, 1, p. 524). In other cases alarming symptoms of depression have been produced by the application of solutions of cocaine to mucous membranes, and when injected before surgical and dental operations (*B. M. J.*, 1887, 1, p. 676; 1888, 1, p. 151).

Deafness; loss of taste and smell; profuse perspiration; intermittent pulse; shallow, irregular, gasping convulsive breathing; impairment of gait and speech; muscular rigidity; convulsive twitchings and paralysis are none of them rare in the cases taken as a whole.

These symptoms are doubtless due to a paralysing effect of the drug on peripheral nerves and may be explained through cardiovascular and respiratory failure.

In the chronic cases or the cocaine habit it is difficult to say what in the nature of neurasthenia is not alleged to be a symptom. Like morphia the habit of taking cocaine seems to sap the moral fibre of its devotees, and they become reckless of everything in their efforts to obtain their dose; lying, cheating, stealing—nothing comes amiss to them so that their craving is satisfied. The cases (*infra*) illustrate these points in some measure, but one must rely chiefly upon clinical experience for evidence.

In tropical climates, Bolivia and Peru, where the coca leaves are chewed, it would appear to have some action on the cortex cerebri, for it seems to render great exertion possible when without the drug such endurance would be impossible.

Treatment.—Nothing but detention in a retreat and strict watching will ever cure the habit. For acute cases emptying of the stomach is naturally the first requisite and then general stimulants such as ammonia, ether, etc. Nitrite of amyl is said also to be of assistance used as an inhalation. Strong coffee, strychnine, and digitalis may also be tried. Chloroform may be used if spasms are violent. Some medical men make it a practice to give a preliminary hypodermic dose of from one-eighth to one-fourth grain of morphia, according to the age of the patient. The physiological antagonism between the drugs is pronounced, so that while morphine is not an absolute antidote it is at least most valuable in counteracting the toxicity of cocaine (*Lancet*, 2, 1898, p. 1209).

Post-mortem Appearances.—Nothing whatever characteristic.

Analysis.—Cocaine may be sought for by the method on p. 352.

To the alkaloidal residue left after the final evaporation of the chloroform and ether mixture, the following tests may be applied:—

1. If a few drops of strong nitric acid are added to a small quantity of solid cocaine, or to one of its salts, and the mixture evaporated to dryness on a water bath, the residue gives, on stirring with a drop or two of a strong solution of caustic potash in absolute alcohol, a distinct odour of ethyl benzoate, recalling that of peppermint, or citronella, or meadow-sweet. Da Silva, who first described this test, considers it to be an extremely delicate one for cocaine, but the odour is scarcely distinctive enough to render the test by itself an absolutely reliable one.

2. If to a few drops of strong sulphuric acid in a porcelain dish some powdered or crystallised resorcin be added, and the mixture moved to and fro a little, the subsequent addition of a small quantity of cocaine produces a splendid blue coloration, changing to a light rose colour on the addition of caustic soda. Goeldner (*Pharm. Zeit.*, 34, 471) states that no other alkaloids give anything approaching to this reaction.

3. If a few drops of a 5 per cent. solution of chromic acid in water are added gradually to a solution of cocaine hydrochloride, each drop produces a precipitate which immediately re-dissolves. If now a small quantity of strong hydrochloric acid be added, a heavy yellow precipitate of cocaine chromate is produced. This reaction is stated by Metzer (*ibid.*, 697) to be peculiar to cocaine.

4. The physiological test may be used by applying a solution of cocaine hydrochloride to the tongue or lips, when a feeling of numbness is produced, due to the local anæsthetic action of the alkaloid (Luff).

Cases.—Percy Smith records (*Journ. Mental Science*, July, 1892) the case of a nurse aged thirty-nine, who entered Bethlem Hospital as a voluntary boarder for the cocaine habit. She had previously been addicted to the use of morphine and laudanum, and her mother had been the victim of the morphine habit. She had commenced to take cocaine about eight months previously, and had gradually increased the dose until ten grains was her usual quantity, though she occasionally took twenty-four and even thirty-six grains at a single dose. For the first six hours after a dose of ten grains she felt more able and inclined for work whilst sitting, but she could not go about, as it produced a feeling of weakness; at the end of that time she would be disinclined to do anything and would lie down, but could not sleep; about a quarter of an hour after a dose she usually suffered from vertigo for an hour and from palpitation for some hours; she also had great dryness of mouth, thirst and anorexia. After a large dose there was difficulty in swallowing. She had hallucinations, and imagined she saw people and heard them talking to her, and used to carry on conversations with them although she knew that they were hallucinations. The hallucinations soon disappeared after her admission, and after four months, including a stay at the country convalescent home, she left apparently well, and two months later reported herself as quite well (*B. M. J.*, Epit., August, 1892, p. 21).

The following is recorded (*B. M. J.*, 1, 1896, p. 1032) by Dr. Barratt:—

A medical man, aged about thirty, gave himself a hypodermic injection of cocaine to relieve local rectal pain. This not proving effectual he repeated the injection about five minutes afterwards, each time filling the syringe completely, the total amount given measuring ♏xl. Immediately after the last injection he noticed that the solution used was a 35 per cent. solution, instead of being, as he had imagined, a 1 per cent. solution. He had by him solutions of the different strengths in bottles of the same size and shape, hence the mistake. The total amount of cocaine hydrochlorate injected hypodermically was therefore about fourteen grains. Feeling weak, he lay down, and I saw him about eight minutes after the second injection. He was then perfectly conscious, with a moist skin, and almost pulseless at the wrist. An injection of ♏v. of ether was given hypodermically, together with some brandy and hot tea by the mouth. The effect of the ether was to cause the radial pulse to revive, but at the end of seven minutes it again became imperceptible. These ether injections were therefore repeated again and again every seven to ten minutes for nearly two and a half hours, being resumed as soon as the pulse became thready. Meantime the patient complained of thirst, drank copious draughts of hot weak tea, perspired very profusely, and passed large quantities of almost colourless urine. He was in a feeble apathetic state, but quite conscious, and there were no convulsions. The ether injections caused scarcely any sensation to pain, although sensibility to touch was apparently unimpaired. At the end of rather more than an hour the heart's action became intermittent, every third beat being missed. A change of posture was suggested, and this symptom passed off after a time. In all two drachms of ether were given hypodermically, and two ounces of brandy by the mouth, and eighty ounces of urine were passed in the course of five hours, the patient taking about the same amount of liquid by the mouth. At the end of three hours it was found possible to leave off the injection of ether, and at the end of five hours the pulse had to a large extent regained its tone, while the weakness was less marked.

Next day the patient stayed at home, and seemed fairly well except that he was dull and had little appetite. On the second day he walked out for about a quarter of a mile, and then became very faint. Otherwise his recovery was uninterrupted, and there were no after ill-effects. The extreme collapse, the absence of convulsions and unconsciousness, and the conjunction of perspiration and polyuria, are the striking features of this case.

In July, 1904, a somewhat unusual case came before the courts, which is thus reported by the *Times*, July 11th, 1904:—

At Gloucester, recently, Mr. Justice Lawrance and a special jury heard an action in which Mr. Albert Edward Freeman, a young man living at Stroud and employed as a carpenter there, sued Mr. Ebenezer Apperly, dental surgeon, of that place, for damages in respect of negligence alleged to have been committed by the latter's son and assistant, Mr. Henry David Apperly, in the stopping of a tooth. The litigation was begun about a year ago, and had a remarkable history. The case was begun in the High Court, and, at the defendant's instance, was remitted, on the ground of the plaintiff's inadequacy of means, to the County Court. It was heard at Stroud, where the jury disagreed. It was re-tried at the Gloucester County Court, where his Honour the learned judge, at the close of the plaintiff's case, held that there was no evidence to go to the jury, and stopped the case. A Divisional Court set aside this decision, and ordered a new trial, giving the costs of the second trial and of the appeal to the plaintiff in any event and directing that at the defendant's option the trial should take place at Gloucester Assizes, with a special jury, costs, however, to be on the County Court scale. The facts, briefly stated, were these:—On Christmas Eve, December 24th, 1902, Mr. Apperly, jun., put a temporary stopping into a tooth of the plaintiff. The dressing consisted of oil of cloves, carbolic acid, carbolised resin, and cocaine lanoline. According to the defendant's case, not more than one-twenty-fifth of a grain of cocaine lanoline was used. After leaving the surgery the plaintiff was dizzy and faint and staggered. The next day the stopping came out at dinner, and the plaintiff had afterwards a repetition of those symptoms. He was seriously ill for some six months.

For the plaintiff it was sought to be shown that the cause of the illness was cocaine poisoning. It was said that Mr. Apperly, jun., had inadvertently used a larger amount of the solution of cocaine lanoline than he thought, and, alternatively, that he ought not to have used cocaine at all without the plaintiff's consent or the authority of a doctor. Cocaine was described as a dangerous and erratic drug, not unlikely to cause serious illness if administered, even in small quantities, to persons susceptible to its effects.

For the defendants a large body of expert evidence was given. Physicians and surgeons were called to testify that the history of the plaintiff's illness was inconsistent with the theory of cocaine poisoning; dentists were called who said that the treatment of the tooth was perfectly right, that the use of cocaine was recognised as correct by all experienced dentists, and that ill results rarely, if ever, followed from its use.

His lordship summed up and left to the jury two questions: Did the plaintiff suffer from cocaine poisoning? If yes, Was the fact of cocaine poisoning due to the negligence or unskilfulness or incompetence of the defendant's assistant?

The jury, without leaving the box, answered "No" to the first question, and they added that, even if the plaintiff had been proved to have suffered as alleged, they would have acquitted Mr. Apperly of all blame.

The learned judge entered judgment for the defendant accordingly.

On this case the editor received the following information from Dr. A. B. Davies, of Stroud:—

"Last Christmas I was sent for to see a patient alleged to be dying. When I got there he was all right, but his friends informed me that he had had several attacks of unconsciousness lasting for a variable time. It appears that the day before he had had toothache and had the cavity of the tooth 'dressed.' A short time afterwards he swallowed the 'dressing,' and since then had felt 'queer' and was under the impression that he had been poisoned. I made light of it, but two days later a certain amount of loss of sensation was felt in both legs, with increased knee jerks. Suspecting that the symptoms might be due to cocaine, I went to see the dentist, and found that he had used a little 'cocaine lanoline' to the tooth. The patient gradually improved, but remained in a neurasthenic condition for months, and was quite unable to follow his occupation (carpenter) because any exertion brought on fainting attacks." Dr. Davies then asks: "Can you tell me of any cases where such symptoms have followed the use of such a small dose of cocaine? Do you think the symptoms were due to the cocaine at all, or were they the result of a certain amount of nervous shock, or possibly hysteria? I may say that he is only twenty-four years of age, and had always previously enjoyed good health. There was no suspicion of malingering. He made at work twenty-four shillings a week, and belonged to no club."

The editor's reply was in accordance with the verdict, and he knows of no evidence to prove that such a small dose could cause symptoms for such a long time, though any other explanation of them may be difficult.

For a case where one grain injected for tooth extraction proved fatal, *vide Lancet*, 2, 1901, p. 533.

A case of recovery after eight to nine grains (*Lancet*, 1, 1895, 281).

A fatal case from swallowing two drachms of a 10 per cent. solution, equal to twelve grains approximately, is reported with autopsy in the *Lancet*, 2, 1895, p. 1104. In recording this case, Dr. Garland gives the following references:—

"A man, mentioned by Haenel (*Berliner Klinische Wochenschrift*, 1888, p. 890), in whom the injection of one and one-third of a grain was followed by a fatal result. Zambianchi (*Gazzetta degli Ospedali*, 1888) also records a case where death occurred in a female after three grains and a half had been administered hypodermically. It is stated that a man died almost immediately after swallowing twenty-two grains (Guy and Ferrier: 'Forensic Medicine,' 7th ed., 1895, p. 626). Montalti (*Lo Sperimentale*, 1888, p. 294) relates in full detail the case of a woman in whom death occurred after twenty-two grains accidentally swallowed. The first published fatal case in England was that of a man who was given in mistake twenty grains and succumbed in about an hour (*Lancet*, February 9th, 1889). A fatal case occurred in Russia from a dose of twenty-two grains administered by rectal injection (*Lancet*, September 28th, 1889). A melancholy interest attached to this case, as the surgeon who in mistake prescribed this overdose immediately afterwards committed suicide. Recoveries have taken place after very large doses taken into the stomach. The most typical case of the kind I am acquainted with is that of a man who swallowed forty-six grains and recovered (Dixon Mann, *loc. cit.*). On the other hand, serious symptoms of poisoning have been occasioned by the hypodermic administration of such doses as the seventh of a grain (Luff: 'Forensic Medicine,' 1st ed., vol. 1, 1895, p. 314) and less than half a grain (Gooding: *Lancet*, February 25th, 1888). One-twentieth of a grain given subcutaneously to a girl gave rise to dangerous symptoms (Hamilton: 'System of Legal Medicine,' 1st ed., vol. 1, p. 429, 1894), and a hundredth of a grain applied to the eye of a patient aged fourteen years has occasioned symptoms of poisoning (*ibid.*). The case I have above reported lends support to the correctness of Mannheim's (*Zeitschrift fur Klinische Medicin*, 1891, p. 380) estimate that the fatal dose of cocaine is about fifteen grains. In the present state of our knowledge it is, however, practically impossible to state the smallest lethal dose, seeing that a dose of two-thirds of a grain has caused death, and so minute a dose as a hundredth of a grain has given rise to symptoms threatening life."

Numerous other cases are recorded in medical journals, but they show no special points, except one, recorded *B. M. J.*, 1, 1897, p. 896, in which alcoholism seemed to predispose to bad effects from small doses of cocaine.

The following is worth attention from its likeness to strychnine poisoning (*B. M. J.*, 2, 1895, p. 1162, recorded by Dr. Johnston):

"About 7.40 a.m. on October 7th, I was asked to see M. C., who was said to have swallowed some cocaine. On arriving a few minutes after, I found a doctor in attendance and the patient dead. Her parents made the following statement: M. C., aged sixteen years, rose about 6.30; after dressing, she went into her father's bedroom, and swallowed some cocaine from a vial on the dressing table to allay the toothache. She then went downstairs. She had just taken two mouthfuls of hot tea when she felt faint, and in trying to go upstairs, fell. She was then assisted upstairs, and sat down on a chair; she then had a convulsion, and fell on the floor. Her father coming in asked her what she had been taking, and she said that she had taken cocaine for the toothache. Immediately thereafter she had a series of six convulsive fits in succession, the arms and legs being most affected, the face least; there was frothing from the mouth, towards the end blood-stained. She never regained consciousness, and at 7.30, when the first medical man arrived, he found no signs of life.

"It was about 6.50 a.m. when she swallowed the drug, so that death took place in forty minutes. The quantity she had taken was about two drachms of a 10 per cent. solution, equal to twelve grains of the salt. The large dose, the fact of its being taken the first thing in the morning on an empty stomach, and the hot tea taken immediately after, would all tend to quicken the effect. The medicine was contained in an ordinary clear glass vial, and the patient's father had procured it without any prescription. There was no post-mortem examination."

Poisoning by Eugenia Caryophyllata (Cloves).

In the *Lancet* for 1898, p. 967, the following paragraph occurs:—

"*Death from Oil of Cloves.*—An inquest was held at Cardiff, on September 27th, upon the body of a man aged forty-eight years. The widow stated that he had drunk 'about a quarter of a half-pint bottle' of oil of cloves, she being under the impression that it was whisky. After hearing the medical evidence the jury returned a verdict that death resulted from an overdose of oil of cloves taken by misadventure." The editor is unable to find any other recorded case of poisoning by cloves, fatal or otherwise: so that this one remains for corroboration.

Poisoning by Fungi (Genera and Sp. Var.): Mushrooms.

Method of Occurrence.—No branch of toxicology has given rise to greater differences of opinion than the study of poisoning by fungi. Some authors have considered nearly every kind of mushroom as unfit for food; whilst others, again, seem to regard nearly every species as edible with safety. In inquiring into the causes of these discrepancies of opinion, it will be found that whilst some species of fungi are undoubtedly to be regarded as poisonous, since they contain an integral poisonous constituent or constituents which may be isolated in a greater or less state of purity, others apparently produce injurious effects only under certain conditions. Mushrooms contain a large quantity of water, and are very rich in albuminous constituents, and are hence prone to decomposition. They are also indigestible, and apt to produce catarrh of the stomach and intestines. The morel and *Hevella esculenta* are highly esteemed kinds of mushrooms, and yet Keber relates the history of six persons, who after partaking of these fungi were attacked with vomiting and diarrhœa which lasted for sixty hours (*Preussische Vereinszeitung*, 1846, No. 32). Poisonings by the common edible mushroom (*Agaricus campestris*) are rare, except when the mushrooms are decayed. No general rule can be laid down for discriminating between edible and noxious fungi. There are now (1910) several monographs on fungi, which give full details as to which are edible and which poisonous (Cook's "Fungi" for example). There is also an excellent leader on the subject in the *B. M. J.*, 2, 1894, p. 658. Dr. Badham's work on the "Esculent Fungi of England" may be consulted, the second edition was edited by F. Currey, a well-known fungologist. W. G. Smith's "Clavis" is another work of reference.

Even the most poisonous species can, it is said by some authorities, be safely eaten after maceration in vinegar, or in salt and water.

Of all the toxic species, *Agaricus phalloides* causes the greatest number of deaths. This is in part due to its white colour giving it some resemblance to the mushroom, to the absence of unpleasant taste and smell, but more especially to the fact that it only gives rise to symptoms many hours after its ingestion, its action being upon the blood, and not as a direct irritant. It is easily recognised by its hollow stem with a large bulb at the base, and its permanently white gills. Koppel found that in the decade 1880-1890 forty persons were poisoned by it. Various cases have illustrated its effects, which are sickness, diarrhœa, abdominal pain, blueness of the surface, sweating, delirium, coma, jaundice, various skin eruptions, sometimes meningitis, but especially hæmoglobinuria, methæmoglobinuria, hæmaturia, bile in the urine, albuminuria, and suppression of urine. Kobert, who has recently been occupied with the whole subject of fungus-poisoning (*Lehrbuch der Intoxikationen*, 1893), separated the poisonous principle and found it to be a toxalbumin, to which he has applied the term phallin. He found an aqueous solution of *Agaricus phalloides*, when injected into the veins of dogs, caused dissolution of the red blood corpuscles; but if the albuminous substances were precipitated by boiling, neither the precipitate nor the fluid was toxic. The further symptoms were multiple ecchymoses and fatty degenerations, especially of the liver. The urinary tubules lost their epithelium, and transudation of hæmoglobin took place. The whole intestinal tract from the pylorus to the anus became intensely inflamed. To phallin *Agaricus mappa*, *virosus*, *recutitus*, and *porphyrius* owe their poisonous qualities.

Agaricus muscarius is less fatal than *A. phalloides*. The active principle here is the muscarine of Schmiedeberg, whose action on the heart is well known. It exists in the fungus in company with another alkaloid, the so-called "pilzatropine," which was to a certain extent antagonistic to it. Muscarine is the poisonous principle in *Agaricus pantherinus* and *Boletus luridus*. According to Kobert, the amanitin of Letellier, which is present in almost all fungi, edible as well as poisonous, of itself was practically harmless to the vertebrata, but it was apt, by the incipient decay of the fungi, to pass into lecithin and neurine, and thus give rise to gastro-enteritis and other symptoms. Cases of poisoning by the small black-spored agarics, such as *A. semiglobatus*, *semilanceolatus*, *campanulatus*, etc., were not uncommon in this country. They are less frequently fatal, because the symptoms, amongst which giddiness and delirium are frequent, occur soon after the ingestion of the poison, and an emetic speedily sets matters right (*B. M. J.*, 1892, 1, p. 304).

Symptoms and Appearances.—The noxious species of mushrooms act sometimes as narcotics, and on other occasions as irritants. It would appear, from the reports of several cases, that when the narcotic symptoms are excited, they come on soon after the meal at which the mushrooms have been eaten, and that they are chiefly manifested by giddiness, dimness of sight, and debility. The person appears as if intoxicated, and there are singular illusions of sense. Spasms and convulsions have been occasionally witnessed among the symptoms when the case has proved fatal. Peddie has related three instances of poisoning by mushrooms (*Edin. Med. and Surg. Jour.*, vol. 49, p. 200), in which the poison acted as a pure narcotic; there was neither pain in the abdomen, nor irritation in the alimentary canal. The narcotic symptoms began in half an hour with giddiness and stupor: the first effect with one patient was, that every object appeared to him to be of a blue colour. The three patients recovered—two of them rapidly. When the drowsiness passes off, there is generally nausea and vomiting; but sometimes vomiting and purging precede the stupor. If the symptoms do not occur until many hours after the meal, they partake more of the characters of irritation; indicated by pain and swelling of the abdomen, vomiting, and purging. In one case of poisoning by mushrooms, there was slight vomiting about an hour and a half after the meal; but no violent symptoms until after the lapse of ten hours. Several cases, in which the symptoms did not appear until after the lapse of fourteen hours, are reported (*Med. Gaz.*, vol. 25, p. 110). In some instances the symptoms of poisoning have not commenced until thirty hours after the meal; and in these narcotism has followed the symptoms of irritation. It might be supposed that these variable effects were due to different properties in the mushrooms; but the same fungi have acted on members of the same family, in one case like irritants, and in another like narcotics. In most cases recovery takes place, especially if there is early vomiting. In the few instances which have proved fatal, there has been greater or less inflammation of the stomach and bowels, with congestion of the vessels of the brain (*Med. Gaz.*, vol. 46, p. 307; vol. 47, p. 673).

A boy, æt. 13, fried and ate for breakfast at 8.30 a.m. two fungi which he had found growing under a tree. He returned to his work without complaint. At noon he had his dinner of pork and vegetables. At 1 p.m. he returned to work, where he remained until 6 p.m., working the whole time without any complaint. Soon after he reached home, he complained of feeling ill, and vomited violently. Purging then followed, with severe spasmodic pain in the abdomen. These symptoms continued throughout the night until 6 a.m. The bowels then ceased to act. At 11.30 a.m. on the second day, he was suffering from constant pain in the bowels, occasionally aggravated; there was tenderness over the abdomen generally, but especially over the course of the transverse colon, with vomiting every ten minutes—great thirst, skin warm and perspiring, pulse ninety, and great depression. At 3 a.m. he was again seen. Vomiting and purging had returned. There was great exhaustion; pulse imperceptible; the action of the heart feeble. He was lying in bed on his back, with the knees drawn up. Sensibility and consciousness were perfect. He complained of great pain in the stomach; there was tenderness over the abdomen, but no swelling of the cavity. In another hour he died, *i.e.*, about forty-four hours after eating the fungi, and about thirty-four after the first setting-in of the symptoms. Others partook of the fungi, but in small quantity, and they did not suffer. On inspection, the heart on the right side contained a little fluid blood. The left ventricle was contracted and empty. The lungs were healthy, and there was only cadaveric congestion. The lining membrane of the stomach and small intestines was throughout injected, the bluish-red appearance diminishing in intensity as it approached the cæcum. There were a few ecchymosed patches near the intestinal end of the stomach. The organ contained six ounces of a brownish liquid, resembling thin gruel. The large intestines were empty and pale, and the spleen was congested; the other organs were healthy (*Med. Times and Gaz.*, 1863, 2, p. 536).

In many of its features, and in the absence of narcotic symptoms, this case resembled a case of acute poisoning by arsenic. The fact that nearly ten hours elapsed before the symptoms of irritation commenced, and that there was no blood in the matters discharged by vomiting and purging, were the most marked differences.

In 1871, two children died from the effects produced by noxious fungi. Several other persons were placed in a precarious condition from the same cause. Some fowls died from eating portions of the mushrooms. Two children, a boy, æt. 8, and a girl, æt. 10, cooked some mushrooms for breakfast. The boy ate greedily of them, but permitted the girl to take only one mushroom. The symptoms produced in both children were similar, except that the boy had them in a severer and fatal form, and the girl recovered. Three or four hours after the meal, the girl was seized with violent pains in the head and abdomen. She vomited several times in the course of the day, was restless, thirsty, and had occasional muscular twitchings of the hands. During the night the symptoms increased in severity, and she slept but little. Next day there was slight diarrhœa. When admitted into hospital, fifty-four hours after the mushrooms were eaten, all the symptoms had nearly subsided. The boy was then collapsed, and died twenty minutes afterwards. His stomach was found empty and contracted; its mucous coat pink, with minute injection, and covered with a thick layer of dryish material. The whole of the small intestines were empty and contracted; the coats thick and firm; the mucous membrane intensely congested, more especially towards the lower part of the ileum, and covered with a thick layer of yellowish material. The liver was fatty (Guy's Hosp. Rep., 1872, p. 228).

A man, æt. 43, and his daughter, æt. 5, suffered severely from eating the *Amanita pantherina.* The earliest symptoms appeared in two hours and a half after the meal. They were thirst, faintness, delirium, nausea, paleness of the face, and cold extremities. After eleven hours, there was stupor with tenderness of the abdomen. In the child, there was cyanosis of the legs with contracted pupils. It was remarked that even fourteen hours after the fungi had been eaten, portions of them were discharged by vomiting from the action of emetics. In the year 1891 one case of poisoning by mushrooms was recorded in England and Wales.

Treatment must be on general and symptomatic lines; there is no specific antidote.

If seen within five or six hours of eating the substance, efforts must be made to empty the stomach, and a brisk saline purgative administered. Strychnine, brandy, hot coffee, etc., are all likely to be useful to counteract the symptoms of depression.

Analysis.—The discovery of portions of the undigested mushrooms in the matter vomited, or a description of the food eaten, will commonly lead to a recognition of this form of poisoning. One of the most poisonous in this country, *Amanita muscaria* or the fly mushroom, renders the water in which it is boiled so poisonous, that animals are killed by it, while the boiled fungus itself has no effect upon them. [The poisonous base is dissolved out.—Ed.] The liquid procured from it is used as a fly-poison, whence the name of the mushroom is derived. It is an autumnal fungus, known by its rich orange-red colour.

Case.—In the *Lancet,* 1909, 1, p. 562, is reported a case of fatal muscarine poisoning from the application to gnat-bites of a liniment containing it.

Poisoning by Gelsemium.

Source and Method of Occurrence.—The root of the plant *Gelsemium sempervirens* is now official for the manufacture of a tincture (dose five to fifteen minims), which enjoys a certain amount of reputation as an analgesic. Besides the official tincture there are two extractives prepared, one a comparatively pure alkaloid, Gelseminine; the other a mere alcoholic extract, termed Gelsemin. Their respective doses are one-sixtieth to one-twentieth of a grain and one-half to two grains, and severe toxic symptoms have arisen from confusion in administering the stronger for the weaker of these substances (*B. M. J.*, 1, 1889, p. 355).

All the recorded cases of poisoning by Gelsemium seem to have been accidental, and no case has yet given rise to a criminal charge.

Toxicity and Fatal Dose.—Gelseminine has a very powerful depressant action on nerves, sometimes causing a tetanic condition. From a case reported by Wormley (*Amer. Jour. of Pharm.*, January, 1870), it appears to belong rather to the irritant than the narcotic class of substances. While, then, it must be admitted to be a poisonous drug, there is no satisfactory evidence to show its minimum lethal dose.

It is, perhaps, a mixture of two alkaloids, one of which paralyses and the other tetanises. One-eighth of a grain by hypodermic injection killed a rabbit in one hour and a half. In fifteen minutes there were symptoms of great distress, and the animal was restless. In forty minutes there was great prostration, inability to move, gasping respiration and the pupils were dilated, but there were no convulsions. From his experiments, Wormley infers that the quantity which proved fatal to the woman in his case could not have exceeded the sixth part of a grain.

Duration.—In the cases recorded below, death took place in four and seven and a half hours respectively.

Symptoms.—In Wormley's case a young healthy married woman took by mistake three teaspoonfuls of fluid extract of gelsemium—a concentrated tincture of the root—containing four hundred and eighty grains to the ounce. She was several weeks advanced in pregnancy. In two hours after taking the extract, she complained of pain in the stomach, nausea, and dimness of vision. These symptoms were followed by great restlessness, ineffectual efforts to vomit, and general perspiration. In four hours the pulse was feeble, irregular, and intermittent. There was great prostration, with irregular and slow breathing. The skin was dry, the limbs cold, the pupils dilated and insensible to light; the eyes were fixed, and there was inability to raise the eyelids. The vital powers rapidly gave way, and, without convulsions, death occurred in seven hours and a half after the poison had been taken.

A muscular man, twenty-eight years of age, after a drinking bout, took about two ounces by measure of fluid extract of gelsemium, to "quiet his nerves." When seen his face was flushed; he was dozing, but could easily be roused, and talked intelligently; the pupils were moderately dilated, reacting to light, and there was slight drooping of both eyelids. The pulse was strong and full, about one hundred. An hour later the dipsomaniac, eluding his watchers, managed to get out to a drug store, and procured half an ounce of fluid extract of gelsemium, which he drank. He was found twenty-five minutes later, sitting in a shop, with relaxed limbs and pale face; but he was capable of speech. As he refused to swallow an emetic, sulphate of zinc was administered through the nose. Copious vomiting followed this, and a second dose that was given. In spite of this he became speedily unconscious; pulse 130; respiration forty, and entirely thoracic; pupils moderately dilated, but acting. Brandy was given subcutaneously and by the rectum, and after faradaisation of the diaphragm and intercostal muscles he rallied from the state of collapse into which he had fallen, only to relapse shortly after, when the same measures were repeated, and also hypodermic injections, first of atropine, then of carbonate of ammonium, and inhalations of nitrite of amyl, were employed. He died about four hours after taking the poison (*Boston Med. and Surg. Jour.*, December 22nd, 1881).

Treatment.—Empty the stomach as quickly as possible. Atropine $\frac{1}{100}$ grain or strychnine $\frac{1}{30}$ grain may be given hypodermically in the hope of counteracting the depressant action of the drug, and nitrites (amyl, nitroglycerine, etc.) may be tried to relieve the heart failure.

Post-mortem Appearances.—Absolutely nothing is to be found even suggestive of this form of poisoning without an exhaustive chemical analysis.

Analysis.—The alkaloid must be extracted by the method on p. 352.

Wormley discovered that the extract contained an alkaloid (*gelsemine*) separable by ether or chloroform, and an organic acid (*gelsemic acid*). The latter he was able to obtain crystallised in various forms by solution and sublimation. He found that if a small quantity of this acid or its salts, in a solid state, was treated with a drop of concentrated nitric acid, it became yellow or reddish, according to the quantity. When an excess of ammonia was added, it acquired a blood-red colour. The hundredth part of a grain was sufficient for this reaction. The solution in potash is fluorescent, presenting a deep blue coloration on the surface. Gelsemic acid was thus detected in the contents of the stomach some months after death.

Gelsemine gives, with strong sulphuric acid alone, a green colour changing to red; strychnine is unaffected by sulphuric acid alone (Luff).

Case.—The following is of interest as a personal narrative. It is reported by Dr. Nankivell (*Lancet*, 1, 1899, p. 1663).

> "I took two ounces of the tincture of gelsemium instead of a glass of sherry, and returning to the dining-room, awaited the result. It was not long forthcoming. (We all live on the ground-floor here.) The few feet travelled to the dispensary found me only too ready to accept the receipt of a helping arm, and in another minute the legs were paralysed. Dragging myself to the bedside with my fore-limbs, they were unable to help me into the bed, into which I was lifted. There was no trouble so long as I lay quiet, but on the least exertion there were excessive tremors. Vomiting occurred during the next twenty-four hours. The temperature rose to 101·5° F. The heart's action was very violent and intermittent, possibly the aggravation of existing disease.
>
> "All the muscles of the eyes must have been affected, but of all the voluntary muscles those of the right side suffered most. Prolonged conversation involved paralysis of the upper lip. The other symptoms were (1) somnolence, (2) no mental excitement, and (3) good appetite. The effect of the drug passed away as it began, from below upwards, but after the arms had recovered vision was not perfect for twenty-four hours."

Poisoning by Helleborus Niger.

Source and Method of Occurrence.—This plant, as a matter of fact, is not a native of England, though we have two, *H. viride* and *H. fœtidus*, which are probably just as noxious. According to Wibmer, the roots of the black hellebore (*Helleborus niger*) possess the greatest activity; but the leaves are also highly poisonous when used in the form of infusion. By long boiling the poisonous properties of the plant are diminished. The roots and leaves have a local irritant action, producing in small doses violent vomiting and purging, with severe pain in the abdomen, followed by cold sweats, convulsions, insensibility, and death. The powdered root, in a dose of a few grains, acts as a drastic purgative. In a case reported by Morgagni, half a drachm of the aqueous extract killed a man, æt. 50, in eight hours. The symptoms were severe pain in the abdomen and violent vomiting. After death the whole of the alimentary canal was found inflamed, but especially the large intestines (Wibmer, *op. cit. Helleborus*). A case is quoted by the same writer in which a tablespoonful of the finely powdered root caused severe symptoms of irritant poisoning, which did not disappear for four hours. The man recovered on the fourth day. The experiments performed by Orfila on animals show that this poison acts like a *local* irritant when applied to a wound (*op. cit.*, vol. 2, 369). Hellebore is a favourite quack remedy for worms, and has been given to procure abortion. It is not, therefore, surprising that it should be occasionally administered in an overdose, and cause death. The reader must, however, be careful to distinguish between these hellebores and the so-called green hellebore, or veratrum viride (*q.v.*).

Toxicity and Fatal Dose.—The toxicity of the plant depends upon two active principles: helleborin and helleborein. The fatal dose is unknown, but half a drachm of a watery extract is recorded as fatal (Mann).

Duration.—Mann states that death has resulted in from three to twelve hours. The case above ended fatally in two hours.

Treatment.—Evacuate the stomach, and counteract the collapse by stimulants, etc. No physiological antidote is yet available.

Post-mortem Appearances.—Quite neutral, but signs of irritation are likely to be present in the bowel and stomach.

Analysis.—Helleborin, but not helleborein, may be shaken out of *acid* aqueous solution with ether; it is still more soluble in chloroform. After evaporation of the solvent the residue immediately yields a bright red colour on being touched with a glass rod which has been dipped in strong sulphuric acid (Mann).

Case.—The following fatal case is from the *Lancet*, 1, 1904, p. 42. It is instructive in many ways. The editor inserts it in full with the remarks:—

"A case of poisoning by hellebore occurring at Sackville College, East Grinstead, was recently investigated by the East Sussex coroner. Evidence was given to show that John Davis, by the advice of a friend, prepared an ointment made from *Helleborus niger* in order to allay an irritable skin disease. On the day of his death, being afflicted with pains in the stomach, Davis swallowed what he thought was a liquorice powder, but in reality was the powder from which he had prepared his ointment. The two powders were kept in similar papers in a canister, and Davis possessed only one eye. He discovered his mistake and proceeded to a druggist's shop in the town with the object of obtaining an emetic. The assistant, who later remarked that Davis's manner was as usual, advised him to consult a medical man at once, but whilst on the way home, and, it is believed, twenty minutes after he had swallowed the hellebore, he was attacked with great pain, and was supported back to the college. Mustard and water proved unavailing as an emetic, and all efforts to procure a medical man were fruitless. Davis remained conscious to within ten minutes of the end, and died within two hours. The coroner remarked that, whilst admitting the poison was one comparatively unknown, no one appeared to be aware of the seriousness of the case, and as Davis had called for a remedy, it was the assistant's place to have given it to him. The druggist pointed out that the poison was not included under Schedule 1 or 2, but, nevertheless, he marked the packet 'Poison.' Mr. James Harrison, warden at the college, gave his testimony. He did not see Davis until within seven or eight minutes of his death. In answer to the coroner, Mr. Harrison stated that the effects of hellebore were that in the first place intense burning in the stomach ensued, and then, as absorption took place, it naturally paralysed the nerve centre governing the heart, resulting, as in the present instance, in heart failure. Olive oil could be given as an emetic, but at present no antidote was known. A teaspoonful was sufficient to cause the death of six men. The coroner remarked that there was comparatively little known of the poison, and the jury returned a verdict of 'Death from misadventure.' Cases of poisoning by hellebore are undoubtedly rare. The symptoms are very similar to those produced by veratrum, and the two poisons may easily be mistaken for one another. Hellebore is strongly irritant to the mucous membranes, and has an action on the heart resembling that of digitalis, and it also acts on the nervous system. Hence in overdoses it produces nausea, vomiting, salivation, and diarrhœa. The primary stimulating action upon the motor centres and the heart may not appear, and the general depression will then be very marked. The heart's action becomes rapid and feeble, and death from syncope is likely to occur. A case of poisoning by hellebore, with recovery, was recorded in the *Lancet*, vol. 2, 1856, p. 100."

Poisoning by Hyoscyamus Niger (Henbane).

Source and Method of Occurrence. — The whole plant is poisonous, but it is chiefly from the seeds that cases have arisen, and from the alkaloids. The plant is moderately common in England, but is unattractive except by its curious lurid flowers.

In 1892, several persons suffered in a slight degree from the ordinary symptoms of poisoning by henbane after partaking of soup flavoured with the seeds, which were sold as those of celery. Two teaspoonfuls of the seeds, weighing about seventy-two grains, were put into the soup (*B. M. J.*, 1892, 1, p. 1075). According to the experiments of Ransom, the seeds contain 0·054 per cent. of alkaloid, which is about the percentage contained in the leaves. Hence presumably one-twenty-fifth of a grain of hyoscyamine produced toxic effects in several persons.

One fatal case of poisoning with the roots of henbane is quoted by Orfila, and another with the leaves is reported by Wibmer (*op. cit.* p. 147).

The fumes evolved from the burning seeds, when inhaled, are a popular remedy for toothache.

The poisonous properties of henbane are known to be owing to the presence of two crystalline alkaloids, which are called *hyoscyamine* and *hyoscine*. These with atropine, the alkaloid of belladonna, are, according to Ladenburg, the only three known natural mydriatic alkaloids, *i.e.*, basic bodies which cause marked dilatation of the pupil of the eye. According to Ladenburg, hyoscyamine is identical with *duboisine*. He is also of opinion that inactive atropine is merely the racemic modification of lævo-rotatory hyoscyamine.

The alkaloids are used medicinally as sedatives, especially in cases of those mentally deranged. *Vide* also "Extra Pharm.," 1904, p. 302, and *B. M. J.*, December 21st, 1895.

Toxicity and Fatal Dose. — The alkaloids themselves are extremely poisonous, the usual doses being of hyoscine $\frac{1}{200}$ to $\frac{1}{100}$ of a grain, and of hyoscyamine $\frac{1}{120}$ to $\frac{1}{140}$ ("Extra Pharm.").

Symptoms.—When the dose is not sufficient to destroy life, the symptoms are—general excitement, fulness of the pulse, flushing of the face, weight in the head for a short time, rapidly followed by giddiness, loss of power and tremulous motion of the limbs, somnolency, dilatation of the pupils, double vision, nausea, and vomiting. After a time these symptoms pass off, leaving the patient merely languid. When a large quantity of the root or leaves has been eaten—an accident which has occurred from the plant having been mistaken for other vegetables—more serious effects have been manifested. In addition to the above symptoms in an aggravated form, there may be loss or incoherency of speech, delirium, confusion of thought, insensibility, coma, and sometimes a state resembling insanity; the pupils are dilated and insensible to light; there is coldness of the surface, cold perspiration, loss of power in the legs, alternating with tetanic rigidity and convulsive movements of the muscles; the pulse is small, frequent, and irregular, the respiration deep and laborious. Occasionally there is nausea with vomiting and purging. Death may take place in a few hours or days, according to the severity of the symptoms. The special effect of this poisonous plant is manifested in its tendency to produce a general paralysis of the nervous system.

Treatment.—The same measures may be adopted as for belladonna poisoning (*q.v.*, p. 687). Pilocarpine and caffein act as antidotes to some extent, and tannin or tea may be administered in the hope of making inert the alkaloid still left in the stomach.

Post-mortem Appearances.—There is nothing to be looked for except bits of the plant. Chemical analysis is the only means of detecting the poison.

When the vegetable has been eaten, it can be identified only by its botanical characters. The seeds are very small and hard; they are furrowed on the surface, and may be easily confounded with those of belladonna. They are of an oblong, oval, or pyriform shape. The leaves are peculiar in shape and other characters, by which they may be easily identified.

Analysis.—The process described on p. 352 must be applied. The alkaloids appear to answer to the same tests as atropine.

Cases.—In the *B. M. J.*, 1, 1896, p. 336, is a case of non-fatal poisoning from the hydrobromate of hyoscine reported by Dr. Morton. One-twenty-fifth of a grain was used. Dr. Morton thus records the case:—

"M. L., aged fifty, suffered from a severe form of cyclitis implicating both eyes, and extending to the choroid and retina. Adhesions had already formed when the case came under observation. The inflammation lasted four months. Atropine, homatropine and cocaine, and atropine alternating with eserine were used with little or no effect. Six drops of a 1 per cent. solution of the sulphate of atropine were used three times a day for a considerable time with little effect on the pupil, and no perceptible effect on the general system except a slight dryness of the throat.

"On the advice of Professor Reid, it was resolved to try hyoscine, as it acted more powerfully and quickly. One grain of the hydrobromate was procured fresh from a wholesale chemist, and made up to a 1 per cent. solution in water. This was rather a strong solution, but, judging from the slight effects of the atropine on the general system, it was thought quite safe to use the hyoscine solution of that strength. It was accordingly directed that for a first trial two drops should be put into one eye. This was done, and, as the patient felt no pain, she put two drops into the other eye as well.

"Five minutes afterwards she complained of giddiness and a feeling of lightness in the head; she staggered, and had to be assisted to bed. Then great dryness of the mouth and throat with thirst supervened. The giddiness increased, gradually the senses became confused, and the power of speech was lost. Complete muscular relaxation became pronounced, and she became rapidly unconscious. The breathing was slow, and occasionally deep and sighing. The face was flushed, the pulse full and regular.

"This unconscious stage lasted for about four hours, and was succeeded by a period of semi-consciousness. At times the patient seemed to have perfectly recovered; at other times she was quite delirious. She talked incessantly, was occasionally irritable, although on the whole it took the form of a pleasant delirium. She recalled funny incidents long since past, made jokes about everybody and everything, and kept those round about her, but for their anxiety, greatly amused with her witticisms.

"After about two hours of this delirium, she became gradually calmer, and then dropped off into a sound and seemingly natural sleep, which lasted for about an hour and a half. When she awoke, she remarked that she had not slept so well for a long time. She had no remembrance of the events of the night further than being assisted to bed. There were no evil after-effects, and by the afternoon, when I saw her, she seemed in her usual health."

The following case, reported by Dr. Given in the *Lancet*, 1, 1904, p. 24, is instructive and noteworthy for many reasons:—

"On October 30th, 1903, a man, aged sixty-nine years, came to me complaining of cramps in the muscles of the legs at night and also of senile tremor of the hands. He had been under my care at intervals for several years. Five years ago I attended him through a severe attack of basic pneumonia, which was accompanied by much excitement, and then one-hundredth of a grain of hyoscine hydrobromate was used hypodermically with great benefit. At the present time he was in fair health for his age. The pulse was rather quick—about ninety per minute. The heart sounds were normal. The urine was high-coloured; it was free from albumen and sugar. I ordered him one-two-hundredth of a grain of hyoscine hydrobromate in one drachm of water to be taken at bedtime. At 9.45 p.m. on the same day I was hurriedly summoned to see him. I was informed that at 9.15 p.m. one teaspoonful of the medicine was given him by his son (this was confirmed by the amount absent from the bottle). After swallowing it he undressed and got into bed. While undressing he remarked to his wife that his throat felt very dry, and she noticed that his speech was rather thick. Two or three minutes after he got into bed his wife heard him breathing very deeply; she tried to rouse him, but could not, and sent for me. I found him half an hour after he had taken the medicine deeply comatose with stertorous breathing and flushed face. His pulse was eighty per minute and regular, his pupils were dilated and equal, and the conjunctival reflex was very slight; I could not rouse him by any means. I injected one-tenth of a grain of strychnine hypodermically and gave one ounce of brandy by the rectum. At 10.45 p.m. there was no improvement; the coma, if anything, was deeper, the conjunctival reflex was quite absent, the pulse was smaller and weaker, and there was some twitching of the arms and legs. I sent for my syphon stomach-tube and for Dr. W. B. Paterson to help me. In the meantime I injected one-sixth of a grain of morphine with one grain of caffeine citrate. In a few minutes the pupils became less dilated, but otherwise there was no change. At 11.45 p.m., with Dr. Paterson's assistance, I washed out the stomach by the syphon tube with hot water, removing a small quantity of partially digested food, and then passed into the stomach about eight ounces of strong black coffee and one ounce of brandy. At 1 a.m. the conjunctival reflex began to return, and the patient flinched on pinching the skin on the inner side of the arm. Improvement slowly set in, the breathing became less noisy, and the pulse fuller and stronger. At 3 a.m. he could be partially roused for a moment by pinching and shouting, but at once relapsed into a somnolent condition; the pupils now reacted to light. At 5 a.m. he made an attempt to speak and swallowed some coffee. At 8 a.m.—that is, eleven hours after taking the dose—he was really conscious and able to speak for the first time, and he thenceforth made an uneventful recovery.

"The prescription, which was for one two-hundredth of a grain of hyoscine hydrobromate in one drachm of water, with orders to send two ounces, was dispensed at a very trustworthy druggist's, and a very unfortunate and dangerous, though instructive, mistake was made in dispensing it. The druggists in question gave me, I am glad to say, every facility for investigating the matter. It appears that they had two establishments. At the one to which the prescription was taken they had no hyoscine in stock, so the dispenser sent a written message to the other place for 0·80 gr. of hyoscine hydrobromate in two ounces of water, which is equal to sixteen two-hundredths of a grain, the exact amount he required for the whole bottle of medicine. The dispenser at the second shop seeing decimals were used, took it for granted that it was a foreign prescription, and that 'gr.' stood for grammes, and sent 0·80 gramme, which the first man sent to my patient. The result of this was that he got more than fifteen times as much as was intended, or about one-thirteenth of a grain. This appears to be a good object-lesson in the danger of the present condition of weights and measures in the Pharmacopœia, where it is now optional for either the decimal system or the apothecaries' measure to be used. Surely the time has come for the rational and scientific metric system to be enforced as the officinal standard.

"The literature of hyoscine poisoning seems to be scanty, and points to the fact that the drug is rather uncertain in its action, sometimes producing poisonous symptoms in very small doses, while in other cases fairly large doses are tolerated. This is probably due to variations in its purity and mode of manufacture. The hyoscine used in this case was Merck's. Professor J. Dixon Mann in his work on toxicology states that in one instance one-fortieth of a grain taken by the mouth produced severe symptoms of poisoning, as did one-thirtieth of a grain given hypodermically in another. On the other hand, Allan Gray (*B. M. J.*, 1892, p. 705) reports a case where one-fiftieth of a grain was used every night with good effect. Dr. L. A. Weatherly, who used it largely in asylum practice, in an article in the *Journal of Mental Science* for July, 1891, states that he considers that the dose should be from one three-hundredth to one-hundredth of a grain, very cautionsly increased in some cases to one-fiftieth. With regard to antidotes, besides those used in this case pilocarpine has frequently been employed. I had it with me, but I did not use it, and I confined myself to the use of strychnine, morphine, and caffeine, the last both hypodermically and as strong coffee, and it is in a great measure, I think, to the last drug that the patient owes his recovery."

POISONING BY HYSSOPUS OFFICINALIS.

Source and Method of Occurrence. — This plant does not grow wild in Britain. The following is the only case of poisoning by it the editor can find, and even this requires confirmation (*Lancet*, 1, 1899, p. 124):—

"A singular case lately formed the subject of a coroner's inquiry where a pregnant woman made an infusion of a pennyworth of hyssop, after taking which she died. She was stated to have been in bad health and the subject of Bright's disease. It is generally believed that the plants of the order to which this belongs—the Labiatæ—have no deleterious qualities, being carminatives and antispasmodics. However this may be as a rule, the medical witness at the inquest expressed his belief that the hyssop was the cause of the patient's death, and the jury adopted his opinion, returning a verdict accordingly."

POISONING BY ILEX AQUIFOLIUM (THE HOLLY).

From some published facts, the berries of this tree appear to produce the effects of narcotico-irritant poisoning. A boy three years old ate a number of them. The symptoms which followed were sickness, pain in the head and abdomen, and much purging. Many of the berries of the common holly were passed in the motions; drowsiness supervened, and there was loss of consciousness. In twenty-four hours his face was pale; the skin pale and cool; pulse eighty, weak and small. The pupils were much contracted, but were sensible to light. The vomiting had ceased, but there was some purging. Castor oil and stimulants were given, and on the second day the child recovered (*Lancet*, 1, 1870, p. 573). Wibmer speaks of these berries as having merely a purgative action.

POISONING BY JATROPHA CURCAS (PHYSIC NUT).

The *Jatropha curcas* is a West Indian plant which produces seeds containing an acrid oil, having some of the properties of croton oil. Four seeds act as a violent cathartic, and severe vomiting and purging have been produced by a few grains of the cake left after the expression of the fixed oil from the bruised seeds. The oil operates powerfully in a dose of from twelve to fifteen drops. It produces a burning sensation in the throat, vomiting, purging, and other symptoms of irritation, followed by inflammation of the stomach and bowels. One hundred and thirty-nine children in Dublin suffered from the effects of these seeds (*Med. Times and Gaz.*, 1858, 2, p. 143); and in 1864 a number of boys at Birmingham suffered severely from eating some of these nuts which they had found in a drug store, but they all recovered. Chevallier refers to a case in which thirty-three persons were poisoned by eating these seeds. The symptoms from which they suffered were nausea, vomiting, and general depression. Twenty were so ill that they were placed in the beds of a hospital; the remaining thirteen soon recovered. The albumen of this seed is said to have a flavour resembling that of the almond ("Ann. d'Hyg.," 1871, 1, 408).

The *Jatropha urens*, also a West Indian plant, is said to produce serious effects upon those who touch its leaves, which are covered with stinging hairs like those of the nettle. The wrist of a person accidentally came in contact with some of the hairs. In a few minutes there was swelling of the lips, redness of the face, faintness, great prostration of strength, and such a degree of collapse, that for some minutes the sufferer was thought to be dead. He then rallied; there was sickness, and in twenty minutes the man recovered. In another case the pain and swelling in the part touched lasted for some days, and an itching sensation continued for a longer period (*Pharm. Jour.*, April 17th, 1872, p. 863). Assuming this account of the symptoms to be correct, the poison connected with the hairs not only has a local action, but it is very rapidly absorbed, and produces effects resembling those of serpent poisons.

POISONING BY JUNIPERUS SABINA (SAVIN).

Source and Method of Occurrence.—This is a well-known plant (but is not a native of Britain), the leaves of which contain a poison in the form of an acrid volatile oil of a remarkable odour. They exert an irritant action, both in the state of infusion and powder. They yield by distillation a light yellow oil, on which the irritant properties of the plant depend. The powder is sometimes used in medicine, in a dose of from five to twenty grains. Savin is not often taken as a poison for the specific purpose of destroying life, but this is occasionally an indirect result of its use as a popular means of procuring abortion; in this manner it has proved fatal. From the little that is known of its effects, it acts by producing violent pain in the abdomen, vomiting and strangury. After death the gullet, stomach, intestines, and kidneys have been found either much inflamed or congested. It has probably no action as an abortive, except, like other irritants, by causing a violent shock to the system, under which the uterus may expel its contents. Such a result can never be obtained without placing in jeopardy the life of a woman; and when abortion follows she generally falls a victim. On the other hand, a female may be killed by the poison without abortion ensuing. In 1845, the author met with a case in which death had been caused by savin powder, abortion having first taken place. Eight ounces of green liquid were found in the stomach, which, with the gullet and the small intestines, was highly inflamed. The poison was easily identified by placing some of the minute portions of the leaves found in the stomach under a microscope (*Med. Gaz.*, vol. 36, p. 646). The *oil of savin* is also powerfully irritant. For an account of this, see "Criminal Abortion," p. 162.

POISONING BY LIGUSTRUM VULGARE (PRIVET).

Source and Method of Occurrence.—The privet is not commonly enumerated among vegetable poisons. No reference is made to this plant in the works of Wibmer, Orfila, Christison, and other writers on toxicology; and yet it would appear, from the subjoined cases, that the *berries* may exert a poisonous action. In 1853, three children ate the berries of the privet; two of them, a boy of three years of age and a girl of six, eating them rather freely. They suffered from violent purging, and when seen by a medical man the boy was found pulseless and cold, and before death he was frequently and violently convulsed. The girl was in a state of collapse, but rallied a little under treatment. Soon afterwards she died convulsed. The surviving child, who had only tasted the berries, did not suffer, and she was enabled to point out the shrub the berries of which they had gathered. In 1866, a child, æt. 2, died thirty-seven days after eating these berries, symptoms of irritation continuing more or less throughout. According to Loudon, they are eaten by birds when other sources of food fail.

In May, 1872, two children, aged twelve and eight years respectively, ate a quantity of leaves and shoots proved subsequently to have been those of the privet. The symptoms in both cases were drowsiness, convulsive twitchings, difficulty in moving about, loss of muscular power, severe vomiting and purging, the evacuations being of a greenish colour. They both recovered.

Cases.—The following references, with the recent case, are from the *Lancet*, 1, 1898, p. 665:—

"In 1857, thirty-seven children suffered from poisonous symptoms after eating freely of acorns and privet berries. The symptoms were shrivelled appearance of the hands and face, cyanosis, intense thirst, and sickness; opisthotonos was a marked symptom in each case. All the children recovered.

"On February 18th, 1898, an inquest was held at York Town on the body of a female child, aged eight years, who died two days previously after a few hours' illness. On the 16th she complained of pain in the head and stomach. At dinner-time she seemed better, but whilst food was being prepared she gave a cry and became unconscious, and death took place before the arrival of a medical man. The child's teeth were tightly closed, her tongue protruding and her hands clenched, At the post-mortem examination the heart, liver, and kidneys were found to be quite healthy. The lungs were congested. The stomach was also much congested, with one patch of superficial ulceration about the size of a shilling. On inquiry it was found that the child had eaten privet berries. None of those were found in the stomach, but they had probably been discharged by vomiting. The symptoms were in accord with the previously reported cases to which we have referred, and we cordially commend the coroner's remarks that he hoped the evidence as to the privet berries would be a caution to parents as to their danger."

Again, the *Lancet*, 1, 1899, p. 1130, states that:—

"An inquest was held at Stroud, Gloucestershire, on April 11th, upon a female child, aged twenty months, who had died after eating the berries of the common privet. Mr. Embry, the analyst for the county, examined the contents of the stomach."

Poisoning by Lobelia Inflata (Indian Tobacco).

Source and Method of Occurrence.—This plant is imported from North America. Its leaves contain an acrid principle, lobeline, which is capable of producing poisonous effects on the brain and spinal cord, especially on the respiratory centre of the medulla. The plant also produces irritation of the stomach and bowels. When administered in doses of from ten to twenty grains, lobelia acts as an emetic; but in larger quantity it acts deleteriously, and in smaller doses has an expectorant and antispasmodic action somewhat similar to that of tobacco. It would also appear that even ordinary medicinal doses affect some persons with great severity. There used to be a notion that it was only a useful medicine and not a poison, although, like arsenic and opium, it may be either, according to the mode and dose in which it is employed.

It is now official in the form of tincture prepared from the dried flowering herb, of which the dose is 5 to 15 minims. The *seeds* of lobelia are also poisonous. In the *Med. Times and Gaz.*, 1853, 1, p. 270, and 2, p. 568, two cases are reported in which the seeds proved fatal.

There have been many inquests and trials for manslaughter in this country as the result of the improper administration of the powdered *leaves* of the *Lobelia inflata* by quacks and dealers in vegetable medicines. The medical evidence given on these trials has proved that in large doses lobelia is a most noxious drug (see *Med. Gaz.*, vol. 44, pp. 383 and 384; vol. 46, p. 384; *Lancet*, 1853, 1, p. 237; *Pharm. Jour.*, August, 1851, p. 87; and for some remarks on the action of the poison see a paper by Curtis and Pearson, *Med. Gaz.*, 1850, vol. 46, p. 285). Those who profited by the sale of this drug among the ignorant poor used to maintain the doctrine that it could not kill, and never had been known to destroy life.

In 1856, one of these quacks was convicted on a charge of manslaughter for killing a woman with overdoses of lobelia. Severe pain, followed by loss of consciousness and congestion of the brain, were the chief symptoms preceding death in this case. The admission that, in proper doses, it was a useful remedy in spasmodic asthma, was of no avail on this occasion. The man was sentenced to three months' imprisonment (*R.* v. *Boyden* or *Jackson*, Lincoln Sum. Ass., 1856).

Toxicity and Fatal Dose.—The toxicity of the plant would appear to depend on the alkaloid (lobeline) contained in it, but there are no facts to determine the exact fatal dose of this, but in the case reported under "Symptoms," a drachm of the powdered leaves proved fatal.

Duration.—From a few minutes to thirty-six hours seems to be the variation in the total duration of fatal cases. As with other irritants, the effects on the stomach appear within a few minutes of swallowing the drug, but the rapidity with which the effects upon the nervous system appear would seem to depend upon the state and contents of the stomach at the time of taking the poison.

Symptoms.—These would appear to be variable, probably according to whether the main effects were local on the stomach or whether they were exerted after absorption.

In one case, the victim was seen by a medical practitioner soon after he had taken the poison: he was evidently suffering great pain, but he was quite unconscious; the pulse was small, and the pupils were strongly contracted and insensible to light. He had vomited the greater part of the poison. He suffered from spasmodic twitchings of the face, sank into a state of complete insensibility, and died in about thirty-six hours.

Treatment.—This must be entirely upon general principles, *vide* p. 334. There is no specific antidote, but presumably hypodermic injections of strychnine would offer the best chance, with hot coffee by the mouth or rectum.

Post-mortem Appearances.—Beyond finding bits of the plant which might be identified, it is not to be expected that anything will be found in any way characteristic of lobelia, though the appearance of the stomach will possibly suggest "irritant poisoning."

On inspection of the body of the case reported under "Symptoms," some fluid was found in the stomach, but none of the powder. The mucous membrane was intensely inflamed, and the vessels of the brain were strongly congested (*Pharm. Times*, May 1st, 1847, p. 182).

In one case in which the seeds proved fatal, the mucous membrane of the stomach was highly inflamed. In 1882, a man suffering from heart disease, and who was an enormous eater, took as an emetic a medicine containing lobelia prepared from one of Dr. Coffin's prescriptions. At the post-mortem examination, made twelve hours after death, an aperture about the size of a goose-quill was found in the lesser curvature of the stomach, and about two pints of fluid having a milky appearance in the peritoneal cavity. [This aperture had probably nothing to do with lobelia poisoning.—Ed.] The stomach itself contained lobelia seeds and cayenne pepper. The dictum of the so-called Coffinites is that "heat is life, and the want of heat disease and death." In accordance with their principles, their drugs are lobelia and cayenne (*B. M. J.*, 1882, 2, p. 24).

Analysis.—Lobelia is seen in the form of a greenish-coloured powder (fragments of leaves). This powder acquires a reddish brown colour with strong nitric acid, and is blackened by concentrated sulphuric acid. Iodine water has no effect upon the infusion. The ferrous and ferric sulphates produce with it a dark green colour, the ferric sulphate very rapidly.

The leaves of lobelia are generally seen in fragments which do not readily admit of identification by the microscope. The *seeds* are very small, of a lengthened oval shape, reticulated on the surface with projecting hairs or fibres, and of a light brown colour. The discovery of them among the fragments of leaves would furnish a sufficient proof of the presence of lobelia.

The leaves and seeds contain the alkaloid, which may be sought for by the processes described on p. 352, and when obtained in comparative purity, the following corroborative tests may be applied :—

1. Strong sulphuric acid produces with lobeline a red colour.

2. Lobeline gives with sulphomolybdic acid a violet colour. A similar colour is given by morphine, but morphine is a solid substance, lobeline a liquid ; moreover, morphine does not give a red coloration with strong sulphuric acid, as lobeline does (Luff).

3. Lobeline solutions are precipitated by tannic acid (Watts' Dict.).

Cases.—A man named Riley Drake was convicted in the United States of having caused the death of a woman by administering lobelia in improper doses (Wharton and Stille's "Med. Jur.," p. 522).

In 1884 a herbalist was acquitted when tried for manslaughter of a woman named Sainsbury. The deceased, who was suffering from chronic lung disease, took some of the prisoner's medicine, the essential ingredient of which was lobelia. She died in a few minutes. At this trial many herbalists and two medical men swore that lobelia was not a poison (*R.* v. *Wallis*, C. C. C., January, 1884).

The editor cannot find any more recently reported cases.

Poisoning by Lolium Temulentum (Bearded Darnel).

Symptoms and Effects.—Poisoning by darnel is generally the result of accident from the intermixture of the seeds of this grass with wheat or rye. The seeds are ground into flour and eaten with the bread.

In January, 1854, Kingsley, of Roscrea, furnished the author with the particulars of some cases in which several families (including about thirty persons) suffered severely from the effects of bread containing, by accidental admixture, the flour of darnel seeds. The persons who partook of this bread staggered about as if intoxicated: there was giddiness with violent tremblings of the arms and legs, similar to those observed in delirium tremens, but of much greater intensity (the patients requesting those about them to hold them, and experiencing great comfort from this assistance being given) ; greatly impaired vision, every object appearing of a green colour to the sufferer ; coldness of the skin, particularly of the hands and feet; great prostration of strength, and in several cases vomiting. Under the free use of stimulants and castor oil, the whole of the patients were convalescent on the following day, but much debilitated from the effects of the poison. Among the symptoms in other cases there has been noticed a sense of burning heat in the mouth and throat, with confusion in the head, trembling, and a small, irregular pulse (see *Edin. Month. Jour.*, August, 1850, p. 180).

Analysis.—Bley extracted from darnel a bitter principle, *loliin*, which needs further investigation.

Poisoning by Manchineale Tree.

Source and Method of Occurrence.—The following case, reported by Dr. Caddy (*B. M. J.*, 1895, 1, p. 136), is the only one the editor is able to find. The plant apparently grows in the Grenadine Islands. The smell of the apple-like fruit is delicious, and has been the cause of many a sailor in these regions meeting his death from eating it.

"On June 2nd, 1894, a black child, aged five years, was admitted under the following circumstances: The mother stated that the child had been playing with some other children on the previous evening by the seashore, when she suddenly came running home crying violently, and complaining of severe pains in her 'mouth and belly.' She was very sick, but could not swallow food or water, and passed a very bad night, screaming loudly at times, and being extremely restless. Early the following morning the mother brought the child to the hospital, and upon my questioning her said that the child had been poisoned from eating some manchineale from one of the trees under which she had been playing. I found the child in a state of collapse, the surface of the body being bathed in a cold sweat, the radial pulse imperceptible, heart sounds hardly distinguishable, respirations thirty and very shallow, temperature 96·2° F. The lips were much swollen and covered with blisters, and the tongue was enormously swollen and blistered, interspersed with white eroded patches. There were also blisters in the palm of the right hand, and two small ones on the left. On palpation the abdomen was very tender, this being much exaggerated over the epigastric region. The pupils were widely dilated.

"I at once ordered the child to be placed in bed and surrounded by hot-water bottles, and injected subcutaneously ether sulph. ♏xxv. The child gradually rallied, and the after-treatment consisted in washing out the mouth with glycer. boracis, and the administration of the following mixture: ℞ tinct. opii, ♏x.; potass. brom. ʒss.; potass. chlor. gr. xx.; sod. bicarb. ʒj.; bismuth. subnit. ʒj.; mucilag. acaciæ ʒj.; aquæ ad ℥ij.: ʒj. every two hours, to be allowed to trickle down the throat a few drops at a time. An enema consisting of brandy ℥j., starch ℥ij., and beef-tea ʒij. was given, but as this appeared to distress the patient, it was discontinued, and 'zyminised nutrient suppositories' every four hours substituted. On June 4th the temperature rose to 101° F., and as the patient was unable to swallow even a few drops of water, and ice could not be procured, the mixture had to be discontinued, and hypodermic injections of morphine sulph. gr. $\frac{1}{16}$ were given every five hours, while, to cope with the intense thirst, an enema of cold water was given every two hours, which appeared to cause great relief to the patient. The urine was excreted very copiously, and contained a trace of albumen. On June 6th the patient had decidedly improved, and continued to do so up to June 20th, when she was discharged well."

POISONING BY MENTHA PULEGIUM (PENNYROYAL).

Source and Method of Occurrence.—This plant, though a native of Britain, is not common nor easy to find. It enjoys a vulgar reputation as a means of procuring abortion (*vide* p. 159), and probably it is only thanks to its slight toxic properties that cases of poisoning by it are not more frequent. Its congener *M. piperita* produces the ordinary oil of peppermint.

Case.—"A woman, aged twenty-three years, was admitted to the parish infirmary, Liverpool, on March 15th, in an almost collapsed condition, suffering from symptoms of acute gastritis. She stated that vomiting began four days previously after she had taken a tablespoonful of pennyroyal. She had taken this drug to bring on menstruation, which had been in abeyance for six months. The excessive vomiting continued despite the usual remedies, but ultimately ceased under the influence of morphia and rectal alimentation. The patient, however, gradually sank, and died on March 19th. She had been an inmate of the infirmary for a week at the beginning of the month, and was then suffering from slight anæmia and dyspepsia, but had not vomited during that period.

"A post-mortem examination was made at the direction of the coroner, and I found the stomach extremely congested, especially towards the cardiac end, the small intestines also showed thickening of their coat and intense congestion, most marked in the lower part of the ileum. The large intestines were also congested even down to the rectum, but not to the same degree as the stomach or ileum. The uterus was normal in size, and there was nothing noticeable in the other organs except some congestion of the brain. At the inquest evidence corroborative of the woman's statement was given; but as the druggist who had sold the pennyroyal said that in thirty years' experience he had never heard of a case of poisoning by this drug, the jury returned a verdict that 'death was due to gastro-enteritis set up by some irritant poison,' but did not decide what the poison was. It is in deference to their verdict that I have put the word 'supposed' in the heading to this note. On looking up the literature of the subject I have only been able to find one case of poisoning by pennyroyal, which is recorded in Dixon Mann's 'Forensic Medicine.' In that case a pregnant woman who was seen immediately after taking a one-drachm dose of the drug had vomiting, delirium, and opisthotonos, but subsequently recovered" (*Lancet*, 1897, 1, 1022).

POISONING BY MYRISTICA FRAGRANS (NUTMEG).

Source and Method of Occurrence.—The domestic nutmeg has a certain reputation as an abortifacient if taken in sufficient quantities, as the following case, reported by G. E. Reading (*Therap. Gaz.*, September, 1892), would show.

The patient was a lady, three months pregnant, who, in order to procure abortion, swallowed three powdered nutmegs, and was only prevented by fear of vomiting from taking a larger amount and thus losing the whole. She was well till three hours after, when she vomited several times, and passed into the following condition: low, muttering delirium, with occasional silly laughter, and hallucinations of a ridiculous character. She could be aroused from this by shaking, but would relapse almost immediately. There was also a strong sense of impending death. The pulse was strong and rapid. The treatment adopted was to give a twenty-grain dose of chloral hydrate, which lessened the delirium and allowed the patient to obtain sleep. The delirium continued to recur, however, at intervals for the next twenty-four hours, during which grain doses of calomel were given every hour; the next day the patient was quite rational. It may be added that the object for which the nutmeg was taken was not accomplished, the whole energy of the agent appearing to have been expended on the nervous system and gastro-intestinal tract. The general symptoms of poisoning strongly recall those which appear in some cases of poisoning by cannabis indica (*B. M. J.*, Epit., December 10th, 1892).

In Neale's "Digest," sect. 366, 3, several cases are recorded.

The following is reported by Dr. Simpson in the *Lancet*, 1, 1895, p. 150:—

"On Sunday morning, December 9th, 1894, during my absence, my assistant, Mr. E. Gibb Smith, was called to see a woman twenty-six years of age. His report was as follows:—'I found the patient lying upon the bed in a drowsy condition and very delirious, the delirium taking the form of confusion and mistaking one person for another. There were fairly lucid intervals. She complained of a sensation of great tightness across the chest, of vertigo and faintness upon attempting to stand. She had vomited several times, but unfortunately I was unable to see the vomited matter. The pulse was seventy-five per minute and rather feeble, as was also the heart's action. The pupils were normal. Inquiries of a person in the house elucidated the fact that the patient, a strong, healthy woman, had, being a week over her menstrual period, taken two nutmegs, bruised, in a small quantity of gin. I ordered her to keep in bed and to be given a little strong coffee, with a dessertspoonful of brandy in it, every half-hour. I also prescribed the following mixture every four hours: bromide of potassium, carbonate of ammonia, bicarbonate of soda, spirit of cajeput, and chloroform water.' I saw the patient myself in the afternoon, and found her condition considerably improved, but still showing the symptoms described. I continued the same treatment, and the next day she was very much better, but still had some vertigo and was very weak. I discontinued the coffee and brandy, but kept on with the medicine, and by the following day she was able to get up, though still weak. The case has gone on favourably since. I may add that the nutmegs had no effect whatever in producing miscarriage."

POISONING BY NICOTIANA (SP. VAR.) TOBACCO.

Source and Method of Occurrence.—Tobacco is the leaf of a plant belonging to the natural order Solanaceæ. It contains nicotine as the active principle. Snuff is tobacco ground to a powder. Tobacco has been used homicidally, but far more frequently accident (young children playing with old pipes, etc.) accounts for the cases of poisoning by the substance.

In 1854, a man was charged with the death of an infant, æt. 10 weeks, by poisoning it with tobacco. He placed a quantity of tobacco in the mouth of the infant with the view, as he stated, of making it sleep. The infant was completely narcotised, and died on the second day.

It is probably more extensively used to aid the purposes of robbers than is commonly believed; and there is reason to suppose that porter and other liquids sold in brothels are sometimes drugged either with tobacco or with snuff prepared from it. Scotch snuff is said to be used for this purpose.

In 1891, Sir Thos. Stevenson investigated a fatal case of poisoning by snuff, which appeared to have been given to a drunken man in beer, by way of a joke. He died within about half an hour of its administration.

Husemann states ("Handbuch der Toxicologie") that no less than ten fatal cases are known to him from the use of tobacco enemata. The use of this form of enemata is now happily superseded by other remedies.

Toxicity and Fatal Dose.—While tobacco in the mass cannot be called very poisonous, the alkaloid nicotine is a deadly poison, and, like prussic acid, it destroys life in small doses with great rapidity. A rabbit was killed by a single drop in three minutes and a half. In fifteen seconds the animal lost all power of standing, was violently convulsed in its fore and hind legs, and its back was arched convulsively (opisthotonos). A frothy alkaline mucus escaped from its mouth, having the odour of nicotine (Guy's Hosp. Rep., 1858, p. 355). A case of poisoning by this alkaloid which occurred in Belgium in 1851 was the subject of a trial for murder ("Ann. d'Hyg.," 1851, 2, pp. 147, 167):—

The Count and Countess Bocarme were charged with the murder of the Countess's brother, a M. Fougnies, by administering to him nicotine while he was dining with them at the château of Bitremont. The poison was forcibly administered. The deceased did not survive more than five minutes, and he was not seen living by any of the attendants. The possession of the poison, as well as the moral evidence, fixed the crime on the Count, and he was condemned and executed.

The appearances after death were to a great extent altered or destroyed by the pouring of some strong acetic acid into the mouth and over the body of the deceased, in order to conceal or remove the odour of nicotine. Stas detected the poison in small quantity in the tongue, throat, stomach, liver, and lungs of the deceased, as well as in a wooden plank of the floor near to which he was sitting; and it was this case which led him to devise his well-known process for the isolation of the alkaloids. A second case of poisoning by this alkaloid, and the only case recorded in this country, occurred as an act of suicide in 1858.

A gentleman swallowed a quantity of nicotine from a bottle, and almost immediately afterwards was seen in the act of falling to the floor. He was carried to an adjoining room, but before this could be reached he was dead. The symptoms noticed were that the deceased stared wildly; there were no convulsions, and he died quietly, heaving a deep sigh in expiring.

The quantity of nicotine taken could not be determined. The deceased appears to have been rendered insensible immediately, and to have died in from three to five minutes after having taken the poison. Common experience, as well as experiment, proves that nicotine acts especially upon the heart.

In the *B. M. J.*, 2, 1903, p. 324, it is suggested by Dr. Fränkel that there is another alkaloid in tobacco to which both its pleasures and penalties must be attributed.

Duration.—In this respect the effects of smoking are altered enormously by habit. In the above cases, nicotine acted almost as rapidly as prussic acid.

Symptoms.—Every one is familiar with the depression and faintness, collapse, cold sweats, pallor, and rapid onset of vomiting which smoking produces in one unaccustomed to it. In the above acute cases symptoms hardly existed, death was so rapid. The effects which this substance produces when taken in a large dose, either in the form of powder or infusion, are well marked. The symptoms are faintness, nausea, vomiting, giddiness, delirium, loss of power in the limbs, general relaxation of the muscular system, trembling, complete prostration of strength, coldness of the surface, cold clammy perspiration, convulsive movements, paralysis, and death. In some cases there is purging, with violent pain in the abdomen; in others there is rather a sense of sinking or depression in the region of the heart, passing into syncope, or creating a feeling of impending dissolution. With the above-mentioned symptoms there is dilatation of the pupils, dimness of sight, confusion of ideas, a small, weak, and scarcely perceptible pulse, and difficulty of breathing.

A woman applied some leaves of tobacco to ulcers upon her legs. After some hours she suffered from sickness, dimness of vision, cramps in the legs, and great prostration; she also complained of a numb feeling. On the third day there was great sleepiness, with headache and an irregular action of the heart. In about a week, she recovered her usual health (*Lancet*, 1871, 2, p. 663).

Namias relates an instance of a smuggler being poisoned by reason of his having covered his skin with tobacco-leaves, with a view of defrauding the revenue. The leaves, moistened by perspiration, produced all the effects of poisoning. The pulse was small and feeble; there was faintness attended with cold sweats. The operation of the poison seemed to be principally on the heart. Decaisne has observed in persons who have smoked tobacco excessively an action on the heart, indicated by intermission of the pulsations of the heart as well as those of the radial artery (*Edin. Month. Jour.*, August, 1864,

p. 172). The "tobacco heart" of the heavy smoker is now well known to physicians.

Post-mortem Appearances.—There is nothing characteristic, but in the above suicidal case the appearances observed were a general relaxation of the muscles, prominent and staring eyes, bloated features, with great fulness and lividity about the neck. There was no odour resembling nicotine or tobacco perceptible about the body. When examined between two and three days after death, putrefaction had occurred, especially in the course of the veins. The swelling of the neck was found to arise from an effusion of dark liquid blood. The scalp and the membranes of the brain were filled with dark-coloured blood. The lungs were engorged, and of a dark purple colour. The cavities of the heart were empty, with the exception of the left auricle, which contained two drachms of dark-coloured blood. The stomach contained a chocolate-coloured fluid; the mucous membrane was of a dark crimson-red colour from intense congestion. There was no odour excepting that of putrefaction. The liver was congested and of a purple-black colour. The blood throughout the body was black and liquid, but in some parts it had the consistency of treacle. The author found nicotine in small quantity in the contents of the stomach, also in the liver and lungs; but as these organs had been placed in contact with the stomach, it could not be inferred that the poison had been absorbed and deposited in them. [This case is very important as showing the indestructibility of nicotine by the decomposing body, and the value of expert analysis, but the naked eye appearances had nothing to do with the *fact* of nicotine poisoning: the absence of a smell of nicotine must be emphasised, though the explanation is so obvious, viz., that the smell of decomposition entirely prevented it.—Ed.]

Analysis.—Nicotine is a colourless liquid, of specific gravity 1·048, becoming brown on exposure to air, and evolving a peculiar acrid odour affecting the nose and eyes, which when diluted resembles that of stale tobacco-smoke. It has the consistency of a thin oil, and gives a greasy stain to paper, which soon disappears, owing to its volatility. When heated it burns with a bright yellow flame, emitting a thick black smoke. It is powerfully alkaline, and imparts a strongly alkaline reaction to water, in which it dissolves freely. The aqueous solution, even when much diluted, retains the peculiar odour. Nicotine is dissolved by alcohol and ether, and the latter liquid will remove it from its aqueous solution. (1) Platinic chloride produces in the aqueous solution a yellow crystalline precipitate. (2) Corrosive sublimate gives a white precipitate. (3) Arsenio-nitrate of silver gives a yellow precipitate. In all these characters nicotine resembles ammonia. The differences, apart from the odour, which is an important distinction, are—(4) Iodine water gives a reddish brown precipitate (in ammonia there is no precipitate; the colour is discharged). (5) Tannic acid gives a white precipitate (in ammonia there is no precipitate, but a red colour is imparted). (6) Potassio-mercuric iodide precipitates it copiously, even when much diluted. (7) Gallic acid gives no precipitate (in ammonia it produces a pinkish red colour, rapidly changing to an olive green). (8) Sulphuric acid and bichromate of potassium produce a green colour (see Guy's Hosp. Rep., 1858, p. 354).

Organic Mixtures.—To separate nicotine from the contents of the stomach, these should be digested in cold distilled water acidulated with tartaric acid. This liquid is strained, filtered, and the residue pressed. It is then to be evaporated at a gentle heat, and the residue digested with alcohol, filtered, and the alcoholic liquid evaporated. The alkaloid is now dissolved out of the residue by a small quantity of water, and the solution is rendered alkaline by potash and then shaken in a tube with an equal volume of ether; the ethereal liquid is allowed to evaporate in a series of watch-glasses, and if nicotine be present the alkaloid will be left in small oily-looking globules. The odour may not be perceptible until the residue is heated, when its peculiar acridity will be brought out. A few drops of water should be added to the residue in each glass; it will be found to be strongly alkaline, and the different tests may then be applied. It was by this means that the author discovered the poison in the body of the gentleman whose case is related above. In reference to the rabbit killed by a single drop, nicotine was found in the stomach and its contents; there was a trace found in half an ounce of the blood of the animal, and the poison was clearly detected after a week in the tongue and soft parts of the throat of the animal, but there was no trace of nicotine in the liver, heart, nor lungs.

Cases.—In 1902, in New South Wales, an inquest was held on the body of a woman named Doolan under the following circumstances:—For some weeks she had complained of abdominal pain and constipation, for which her mistress gave her castor oil with success. Some time later the constipation and pain in the stomach returned, and upon this occasion she was given a draught, the constitution of which was not stated at the inquest, but of which she had three doses during the day upon which she died. Finding that the draughts had had no effect, the unqualified man who was treating her then cut up about an ounce and a half of "Yankee Doodle" tobacco and put it into about a quart of water for a rectal injection. Directly the injection was given the girl went into a "violent fit," foaming at the mouth; the pain in the abdomen became much worse; the bowels acted. She became then very violent, throwing down those who attempted to hold her; a drink of water was then administered but was vomited at once. She died about twenty minutes after the injection was administered. At the autopsy blood was seen issuing from the nose, and the teeth were clenched. There were no signs of disease nor inflammation internally. The stomach and contents, the liver and kidneys, were reserved for examination. An analysis was made by Will. M. Hamlet, Government analyst, who reported that he found no less than six minims of nicotine in the reserved viscera. The verdict was that the woman died from nicotine poisoning, the result of an enema given by G. D. St. Omer, but that the latter was not guilty of wilful negligence or carelessness.

[There seems to be no reasonable doubt that this patient did die from nicotine poisoning, but the symptoms were peculiar. She had previously had violent hysterical fits, and it is possible that one of these may have been coincident with the fatal incident, and masked the symptoms due to the tobacco. The fact that so much nicotine was found in the stomach after a rectal injection also requires some explanation.—Ed.]

In the *B. M. J.*, 2, 1895, p. 671, is recorded a curious case of poisoning by nicotine owing to a grape-vine being sprinkled with it. It had probably been actually sprinkled on the grapes themselves.

In the *B. M. J.*, 1, 1901, p. 1544, is an interesting case of tobacco poisoning arising through a prisoner trying to conceal some in his rectum. He was very ill, but recovered.

POISONING BY ŒNANTHE CROCATA.

Source and Method of Occurrence.—This umbelliferous plant grows on the banks of rivers, streams, and ditches. It is one of the

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most poisonous of the order, and is considered to be one of the most virulent of English vegetable poisons.

The root of this plant has large tubers on it, which might be and have been mistaken for edible tubers.

Cases of poisoning by this plant are almost always accidental, but it has been used homicidally.

A case occurred in France in which a woman attempted to poison her husband by mixing slices of the root of this plant with his soup. His suspicions were excited by its acrid taste. The woman was tried for the crime, and Toulmouche deposed at the trial that the plant from which the root had been taken was the *Œnanthe crocata*—that it was a powerful poison, and might cause death in two or three hours. The prisoner was convicted (*Gaz. Méd.*, January 3rd, 1846, p. 18; also *Jour. de Chim. Méd.*, 1845, p. 533). Œnanthe is poisonous to animals.

Toxicity and Fatal Dose.—There can be no doubt that the plant is a powerful poison, but the data are too few to make any dogmatic statement on these points.

In 1857, two fatal cases occurred at West Bolden, in Durham. Two labourers ate some of the roots of œnanthe. They were found soon afterwards lying insensible and speechless, with livid faces, tongues swollen and protruded, convulsive movements of their jaws, frothy mucus with blood about their mouths, eyes full and projecting, pupils dilated, breathing stertorous and laboured, with occasional general convulsions. They both died in an hour and a half from the time at which they were discovered.

Duration.—Five minutes from the onset of symptoms seems to be the shortest time on record, and eleven days the longest.

Symptoms.—A number of convicts, while engaged at work, ate the leaves and roots of œnanthe. In about twenty minutes one man, without any apparent warning, fell down in strong convulsions, which soon ceased, but left a wild expression on his countenance. Soon afterwards as many as nine of them fell into a state of convulsions and insensibility. The face of the man first seized became bloated and livid, there was bloody foam about the mouth and nostrils, the breathing was stertorous and convulsive, and there was great prostration of strength, with insensibility; he died five minutes after the symptoms had set in. A second died under similar symptoms in a quarter of an hour, although the stomach-pump was used, and some leaves were extracted with the fluids. A third, who had assisted in carrying the two former, was himself seized with convulsions, and died in about an hour; and soon after him a fourth died, in spite of energetic remedial treatment by cold affusion, emetics, stimulants, stimulating frictions, as well as the use of the stomach-pump. Two other cases proved fatal, the one in nine and the other in eleven days; and in these two cases there was irritation of the alimentary canal. In the others who partook of the roots the symptoms were not so severe. Under the free use of purgatives, a considerable quantity of the root was discharged, and in a few days the men recovered (*Med. Gaz.*, vol. 34, p. 288).

Treatment.—Empty the stomach and give stimulants. No direct antidote is known, but probably strychnine hypodermically would be useful, and hot coffee by mouth or rectum.

Post-mortem Appearances.—These are not in the least characteristic. On inspecting the bodies of those who died quickly there was congestion of the cerebral vessels; and, in one instance, a layer of extravasated blood was found beneath the inner membrane (pia mater). In the first case, which proved most quickly fatal, the cerebral vessels were not congested. The pharynx and gullet had a white appearance, and contained some mucus, with portions of the root. The lining membrane of the windpipe and air-tubes was intensely injected with dark blood. The lungs were gorged with fluid blood. The blood in the heart was black and fluid. The stomach and intestines were externally of a pink colour. The cavity of the stomach was lined with a thick viscid mucus, containing portions of the root. The mucous membrane was much corrugated, and the follicles were particularly enlarged. Similar appearances were met with in all. In the two protracted cases the mucous membrane of the stomach and bowels was softened and thickened. It had a pink colour externally, but no red appearance internally. The vessels of the brain were congested.

Analysis.—*Œnanthe crocata* can be identified only by its botanical characters. The leaves are of a dark green colour, with a reddish-coloured border. They have no unpleasant odour when rubbed. The plant bears a greater resemblance to celery than most of the other Umbelliferæ. Its stem is round, channelled, smooth, branched, and grows to the height of two or three feet. The root, consisting of a series of oblong tubercles with long slender fibres, is of a yellowish white colour, and not unpleasant to the taste. It is the most active part of the plant. The leaves yield much tannic acid to water, and potassio-mercuric iodide produces no precipitate in the decoction. The roots and stems of this plant are more frequently eaten than the leaves. Nevertheless it may be occasionally necessary to identify the plant by the leaves.

Case.—The following is from the *B. M. J.*, 1, 1900, p. 509, reported by Dr. Griffin :—

" J. M., without any previous warning, fell down in a fit in the dining-hall as he was finishing dinner. He was seen by the superintendent, who considered that it was epileptic. He regained consciousness soon afterwards. Whilst being removed from the dining-hall to the ward he had a second severe fit, with vomiting. On arriving in the ward his face was livid, his pupils dilated and fixed ; the conjunctivæ did not respond to the touch ; there was a bloody foam about the mouth and nostrils ; the breathing was stertorous, and there was complete insensibility. He had six severe fits subsequently with an interval of a few seconds between them. The convulsion, which was clonic, was general, but attained its greatest intensity in the lower extremities first, next in the upper extremities, and lastly in the facial muscles. He died before a hypodermic of apomorphine had time to act. It was impossible to use the stomach-pump and give emetics by the mouth, owing to the severe and continuous convulsion. Death was due to asphyxia, and the heart continued to beat for a few seconds after respiratory movements had ceased.

" On the same date T. F. was seized with a severe fit when going out to resume work on the farm after dinner, and vomited a quantity of food whilst being carried into the ward. He was seen at once, and half an ounce of ipecacuanha wine given, which induced vomiting in a few minutes ; the effects of the emetic were kept up by giving the patient tepid water to drink. There was no insensibility in this case, but there was a marked change in the mental state after the convulsions. The patient was delirious and talked incessantly to himself ; was drowsy, and did not like being questioned. His face was pale, the pupils dilated, and the pulse weak and slower than normal. Two hours afterwards he imparted the following information :—

" Between 12.30 and 1 p.m., while at work in a field, he got what he described as a piece of carrot from the patient J. M. He took two bites of this and then threw it into a stream of water at the lower end of the garden. The writer, in company with the head attendant, searched this place and found what looked at first sight like a piece of parsnip in the water. It had a strong disagreeable smell and acrid taste. The broken surface was dotted over with reddish brown spots each the size of a pin's head. These were not present when another part of the root was broken across, and only appeared after exposure to the air for a few minutes. The root of one of the plants which were dug up consisted of as many as twenty oblong tubercles, varying in length from four to eight inches. This plant grows in great abundance in marshy places and by the banks of sluggish streams in the south of Ireland, and country people use it for poulticing boils, carbuncles, and other inflammatory swellings. On the following day T. F. complained of pain and a sense of heat in throat, chest, and hypogastrium, also some difficulty in swallowing. On examination the fauces and pharynx were seen to be congested. Castor oil was given, and strong tea after the vomiting had ceased. This was the only medical treatment used in the case."

Poisoning by Papaver Somniferum.

Source and Methods of Occurrence.—This is a very common fatal poison. In 1891, in England and Wales, 171 deaths were recorded from preparations containing opium. In 1901 there were seventy-two fatal accidents recorded, and fifty-nine suicides, or 131 deaths. Opium, as is well known, is derived from the plant *Papaver somniferum.*

In the Pharmacopœia, there are upwards of thirty preparations containing opium or morphia. There is no rational ground for separating the descriptions of the two in the present work.

Morphine is the chief poisonous alkaloid of opium, of which it forms from 5 to 10, or even 20 per cent. Good opium should yield 10 per cent. of the alkaloid. The British Pharmacopœia states that opium when dry must contain not less than 7½ per cent. of morphia nor more than 10½ per cent. The official dose of opium is one-half to two grains, and of the salts of morphine one-eighth to one-half of a grain.

Owing to its incalculable benefits as a medicine, a large number of proprietary medicines, and also non-official preparations, contain morphine as their essential ingredient, amongst which the following are noticed in previous editions of this work:—

Lactucarium.—Opium is said also to occur in lettuces, but on this Sir Thos. Stevenson wrote:—"The two species of lettuce, the common garden lettuce (*Lactuca sativa*) and *L. virosa*, contain a substance which is possessed of feebly narcotic properties. Orfila found that the extract prepared by evaporation at a low temperature acts upon the brain and nervous system of animals, although very large doses were required for the production of narcotic effects. There is no record of these plants having exerted a poisonous action in the human subject. The inspissated juice of the lettuce is known under the name of *lactucarium*, or *lettuce opium*. The juice, when it first escapes, is of a milk-white hue, but in drying it forms an extract in small irregular, dry masses of a brown colour, a bitter taste, and with an odour similar to that of opium. It has a weak narcotic action when given in doses of from five to twenty grains. It varies much in strength. Wibmer found that two grains caused headache and somnolency. It is bitter to the taste. There are no tests for lactucarium further than the colour, the opiate odour, the want of solubility, and the absence of the other chemical characters of opium. Dymond finds that both the above species of lettuce contain an alkaloid which dilates the pupil of the eye, *hyoscyamine*, the same mydriatic alkaloid as is found in hyoscyamus and belladonna. This alkaloid was absent from dried specimens of lactucarium" (*Pharm. Jour.*, 1891, December 5th, p. 449).

Poppies.—The heads of the white poppy, grown in this country, possess narcotic properties. They yield an inspissated extract called English opium, which, according to Hennell, contains 5 per cent. of morphine. The white poppy-heads, therefore, yield to water, in the form of decoction, a poisonous substance capable of acting deleteriously on children. A child died in consequence of its mother having administered to it two spoonfuls of water in which a poppy-head had been boiled (*Med. Times and Gaz.*, 1863, 2, p. 75). Many cases of poisoning have occurred from the injudicious use of syrup of poppies, a sweetened decoction of the poppy-heads. This syrup when pure is said to contain one grain of extract (opium) to one ounce (Thomson). The common dose of it for an infant three or four months old is half a drachm, for adults two to four drachms. There is some reason to believe that what is often sold by many druggists under the name of syrup of poppies as a soothing or cordial medicine for children, is nothing more than a mixture of tincture or infusion of opium with simple syrup; it is therefore a preparation of variable strength. This may account for what appears to many persons inexplicable, namely, that an infant may be destroyed by a very small dose.

Winslow's "Soothing Syrup."—This remedy, called also "Quietness," appears to be a compound resembling syrup of poppies. Its effects are those of a narcotic. Two doses of this caused the death of a child aged fifteen months, with the usual symptoms of narcotic poisoning (*Pharm. Jour.*, 1872, p. 618). An analysis of this syrup showed that one ounce of it contained nearly one grain of morphine with other opium alkaloids (*Pharm. Jour.*, June, 1872, p. 975). In 1893 a sample was found to contain only one-tenth of a grain per fluid ounce. It is not surprising that it should prove fatal to infants in small doses.

Godfrey's Cordial.—This is chiefly a mixture of infusion of sassafras, treacle, and tincture of opium. The quantity of tincture of opium contained in it is stated, on the authority of Paris, to be one drachm in six ounces of the mixture, or half a grain of opium to one fluid ounce; but it is probable that, like the so-called syrup of poppies, its strength is subject to variation. A case has been reported in which half a teaspoonful ($= \frac{1}{32}$ part of a grain) of opium was alleged to have caused the death of an infant.

Dalby's Carminative.—This is a compound of several essential oils and aromatic tinctures in peppermint water, with carbonate of magnesia and tincture of opium. According to Paris, there are *five minims* of the tincture, or one-third of a grain of opium, in rather more than two fluid ounces of this mixture, or *the one-sixth of a grain in a fluid ounce*. The formula commonly given is—carbonate of magnesium forty grains, oil of peppermint one minim, of nutmegs two minims, of aniseed three minims, tincture of opium five minims, spirit of pennyroyal and tincture of asafœtida of each fifteen minims, tincture of castor and compound tincture of cardamoms of each thirty minims, and of peppermint water two ounces. According to this formula, tincture of opium forms about the $\frac{1}{200}$th part by measure, or one teaspoonful contains about the one-fiftieth part of a grain of opium. Like most of these quack preparations, it varies in strength. An infant is reported to have been destroyed by *forty drops* of this nostrum, a quantity, according to the strength assigned, equivalent to more than *half a minim* of the tincture, or about one-seventy-fifth of a grain of opium. Accidents frequently occur from its use, partly owing to ignorance, and partly to gross carelessness on the part of mothers and nurses.

The quack medicine known under the name of **Locock's Pulmonic Wafers** contains opium. A boy, æt. 4, suffered from all the usual symptoms of poisoning by opium as a result of eating a quantity of these wafers or lozenges (*Lancet*, 1860, 2, p. 420).

Black Drop.—This is a preparation of opium, in which the morphine is combined with acetic acid, and very little meconic acid is present. In the black drop, according to Pereira, verjuice, the juice of the wild crab, is employed as a solvent instead of vinegar. According to Neligan, it is a compound of half a pound of opium to three pints of the expressed juice of the wild crab. It resembles the *Acetum opii*, and has, according to different authorities, from two to four times the strength of laudanum.

Sedative Solution (Battley's).—This is an aqueous solution of opium containing a little spirit and less meconic acid than the common tincture (Pereira). It is considered to have three times the strength of the tincture of opium; but there is so great a difference of opinion on this point, that Neligan represents it as being only of about the same strength ("Medicines," etc., p. 236). He states that it is composed of three ounces of extract of opium, six drachms of spirit, and as much distilled water as will make up two pints. It appears to be in some cases an energetic preparation. One drachm and a half of it has proved fatal to a lunatic, and twenty minims of the solution has destroyed the life of an old woman.

A medical gentleman, lying dangerously ill from an attack of dysentery, took, by mistake, about seven drachms of Battley's solution. Within five minutes salt and water with mustard were administered, and twenty-four grains of sulphate of zinc. Vomiting ensued; the emetic was repeated, and with the same effect, the fluid evacuated at the second vomiting having the usual smell of opium. Half a drachm of ipecacuanha was subsequently given to complete the emptying of the stomach. Notwithstanding repeated vomiting, symptoms of narcotism presented themselves speedily, with contraction of the pupils and great drowsiness, rendering it necessary to remove the patient from bed in his debilitated state and keep him constantly moving for about seventeen hours, when vomiting came on spontaneously, and he was put to bed and allowed to sleep. The original disease afterwards resumed its course (complicated by an attack of gastritis), and at length terminated favourably; but the patient had no recollection of what had occurred for twenty-four hours after the administration of the emetics, and it appeared to his medical attendants that an excited state of mind remained for some days afterwards (*Prov. Jour.*, January 28th, 1846, p. 42). The death of Dr. Baddeley from a dose of this medicine furnishes an additional proof of the dangerous uncertainty of its strength.

Chlorodyne.—[Owing to the great success of this preparation it was analysed as accurately as possible, and the result of the analysis made official under the title tinct. chloroform et morph. co.—Ed.]

A lady, æt. 23, had been accustomed to take this liquid for the relief of pain in doses of as much as sixty drops. She was found dead in bed, and the cause of death was referred by her medical attendant to her having taken two doses without letting a sufficient interval elapse between them (*Lancet*, 1871, 2, p. 697).

According to E. Smith, chlorodyne is thus constituted:—Chloroform four fluid drachms, hydrochlorate of morphine twenty grains, ether two fluid drachms, oil of peppermint eight minims, prussic acid six fluid drachms, mixture of gum acacia one fluid ounce, and treacle four fluid ounces (*Lancet*, 1870, 1, 72). There is reason to believe that this compound is not uniform in composition. According to another formula, the tinctures of lobelia and capsicum, sulphate of atropine, or extract of belladonna, and extract of liquorice, are introduced. One sample, on standing, separated into two liquids, one light and of a pale straw colour and the other heavy and of a brown colour and syrupy consistency. On evaporation it left half of its weight of solid residue as saccharine matter. Another sample remained in a thick syrupy state. A fluid drachm of the first sample left as a residue twenty-seven grains of a brown saccharine extract. Prussic acid may be detected in it by the reaction of the vapour on silver nitrate. Crystals of cyanide of silver are obtained after some time. Morphine may be detected in it by shaking a portion with a mixture of disulphide of carbon and iodic acid. The disulphide acquires a pink colour owing to the separation of iodine by the morphine. Deaths from chlorodyne are frequent. Various preparations contain from one to six grains of hydrochlorate of morphine per fluid ounce. According to Sir Thos. Stevenson, it contains about three grains of this salt per fluid ounce, and the prussic acid is now omitted. [It is included in the pharmacopœial substitute, viz., tinct. chlorof. et morph.—Ed.]

The action of chlorodyne on the pupils is not uniform; and this want of uniformity of action has been attributed to atropine, an alkaloid the presence of which has never with certainty been demonstrated in chlorodyne. Some hold that in small doses chlorodyne does not contract the pupils, and this statement is in accordance with the claims of its inventor. Others hold that in large doses the nostrum does cause contraction. No precise statement can be made on this point. Usually in fatal and dangerous cases there is contraction. In a case which occurred at Brighton in September, 1891, where a child had chlorodyne given to it, and the child was subsequently immersed in the sea, there was dilatation of the pupils (*R.* v. *Green*, Lewes Ass., December, 1891). Dowse records the following case.

A man was found on the pavement, and by him an empty one-ounce bottle of Collis Browne's chlorodyne, and his breath smelt strongly of the liquid. The countenance was livid, the pulse 160 per minute, small and weak, the respiration irregular; and the pupils were alternately dilated and contracted. Later they became contracted for half an hour. The patient was treated early, never became absolutely comatose, and recovered (*Pharm. Jour.*, 11, 1869-70, p. 282).

Nepenthe.—In a case tried at the Chester Assizes, the nature of the compound sold under the above name was a subject of inquiry. It is a pale sherry-coloured liquid, of a spirituous odour, with the smell of opium, and an acid reaction. It contains 3·4 per cent. of solid matter, consisting chiefly of a purified extract of opium with a small quantity of sugar. It also contains a trace of tannic acid, which causes a darkening of the liquid when a ferric salt is added to it for the detection of meconic acid. This disappears, and the red colour of ferric meconate is brought out when a small quantity of diluted sulphuric acid is added to it. Morphine is readily detected in it by shaking with iodic acid and disulphide of carbon. The disulphide acquires a pink-red colour. It may be regarded as a purified alcoholic solution of meconate of morphine, with a little excess of acid, and of about the same strength as laudanum. It has a similar mode of action. A very small quantity has sufficed to destroy the life of an infant.

An infant fourteen days old died under the following circumstances. Some dill-water was procured at a druggist's, and it was put into a bottle which had contained nepenthe. A teaspoonful was given to the infant. It soon fell asleep, and died in a short time under all the symptoms of narcotic poisoning (*Pharm. Jour.*, 1872, p. 779).

For a complete list of the **other non-official preparations** of opium and morphia the reader is referred to Squire's "Comp. to the Brit. Pharm. of 1898," under the heading of "Opium," also to the "Extra Pharm." of 1904.

Toxicity and Fatal Dose.—The medicinal dose of opium in *extract* or *powder* for a healthy adult, is from half a grain to two grains. Five grains would be a fatal dose to most persons. The medicinal dose of the *tincture* is from five to fifteen minims. The tincture of opium of the British Pharmacopœia (laudanum) is now standardised to contain ·75 per cent. of morphine. This is in about the proportion of fourteen and a half minims of the tincture to one grain of dry opium. The *smallest dose of solid opium* which has been known to prove fatal to an adult was in the case of a man æt. 32, who died very speedily in a convulsive fit, after having taken two pills each containing about one grain and a quarter of extract of opium. This quantity is equivalent to *four grains* of crude opium (*Med. Gaz.*, vol. 37, p. 236). The *smallest fatal dose of the tincture recorded* in an adult is *two fluid drachms* (*Edin. Med. and Surg. Jour.*, July, 1840, p. 151). The patient was a robust man, æt. 56; he swallowed the tincture at ten in the evening, and died under the usual symptoms on the following morning, the case having lasted only twelve hours. The quantity actually swallowed, however, appears to be involved in some doubt; for it is subsequently stated that *half an ounce* of laudanum may have been taken. In another case a lady died from a dose of two drachms of laudanum mixed, it was supposed, with chloroform. Large doses of the tincture have frequently been taken without proving fatal. The author has elsewhere recorded a case in which five ounces of laudanum were taken without even producing sleep, and the patient recovered (Guy's Hosp. Rep., 1850, p. 220). He has, however, known three-quarters of a grain of opium in solution kill an aged woman.

Action of Opium on Infants.—In connection with this subject, it is important for a medical jurist to bear in mind that *infants* and young persons are liable to be killed by small doses of opium; they appear to be peculiarly susceptible to the effects of this poison.

A child, four months old, was nearly killed by the administration of one grain of Dover's powder, containing only one-tenth part of a grain of opium. The child suffered from stupor and other alarming symptoms. In 1822, four grains of Dover's powder, containing two-fifths of a grain of opium, were given to a child four years and a half old. It soon became comatose, and died in seven hours. Death was referred to inflammation of the throat, but there was no doubt, from the evidence, that death was caused by the opiate medicine. Thorn met with the case of an infant, only three days old, to which ten grains of Dover's powder, containing one grain of opium, were given by mistake. It suffered from the usual symptoms, but survived for the long period of forty-four hours. Kelso met with an instance in which a child, nine months old, was killed in nine hours by four drops (? minims) of laudanum, equal to about *one-fourth part of a grain* of opium; it was much convulsed before death. A case is referred to in the *Medical Gazette* in which two drops (? minims) of laudanum, equal to about the *seventh part of a grain* of opium, killed an infant. A nurse gave to an infant, five days old, *two drops* (? minims) of laudanum at about three o'clock in the morning. Five hours afterwards the child was found by the medical attendant in a state of narcotism. It was revived by a cold bath, but a relapse came on, and it died the same evening, about eighteen hours after the poison had been given to it. The fatal dose here, as in the former case, was equal to one-seventh part of a grain of opium. An infant, *seven days* old, died in eighteen hours from the effects of *one minim* of the tincture, or *one-fifteenth part of a grain* of opium (*Lancet*, 1854, 1, p. 419). Coma with the usual symptoms was complete in half an hour. The smallest fatal dose recorded in an infant was in a case communicated by Edwards, of Liverpool (November, 1857). An infant, four weeks old, died from the symptoms of poisoning by opium in seven hours after a dose of paregoric elixir, equivalent to *one-ninetieth* of a grain of opium, had been administered to it.

With a knowledge of these facts, it is not surprising that infants are occasionally destroyed by opium under circumstances in which an adult would not suffer.

In December, 1860, an inquiry took place at Chester respecting the death of a child, aged six weeks, under the following circumstances. A fomentation composed of laudanum and gin was applied to the side of the mother, and the child was put to the breast shortly afterwards. The child fell into a sleep from which it did not awaken, and died, in spite of treatment, the next morning. The cause of death was left obscure; but it is not improbable that the child drew a quantity of laudanum into its mouth sufficient to destroy life (*Med. Times and Gaz.*, 1861, 1, p. 70).

In some instances infants have been found to manifest an astonishing power of recovery.

An infant of six months recovered after having had administered to it ten grains of Dover's powder, equal to one grain of opium (*Lancet*, 1850, 1, p. 698); and in January, 1852, an infant of nine months recovered under treatment from a dose of two teaspoonfuls of laudanum, given by mistake. This quantity left by evaporation four grains of an impure extract of opium. In 1860, an infant of between two and three months old recovered after *five grains* of opium had been given to it by mistake for rhubarb. Hays met with a case in which a child, not quite six years old, swallowed a powder containing *seven and a half grains* of opium mixed with powdered chalk. The child was not seen until fourteen hours afterwards. It was at first excited. There had been no vomiting. The narcotism was at no time very profound; it gradually subsided, and at the end of three days the child had recovered (*Amer. Jour. Med. Sci.*, April, 1859, p. 367).

The Fatal Dose of Morphia.—Several cases are known in which a dose of *one grain* of hydrochlorate of morphine has proved fatal to adults. In one it was taken in solution, in a second in a pill, in a third in a powder; and in a fourth it was administered by hypodermic injection into the tissue under the skin of the forearm.

In the first of the cases (*Edin. Month. Jour.*, September, 1845, p. 195), the morphine was taken in divided doses in six hours. The patient died in about seven hours. The second case occurred at St.·Mary's Hospital in May, 1861. A man, æt. 45, died in thirteen hours from a dose of one grain of hydrochlorate of morphine, prescribed in a pill by one of the physicians. The symptoms came on in about three hours, and were of a well-marked character. No morphine was detected in the stomach nor in the other organs, and its operation as a poison was ascribed, without any apparent ground, to disease of the kidneys. In the third case, a healthy man, æt. 52, died in about ten hours from the effects of *one grain*. Three hours after taking the powder he passed into a comatose condition, from which he did not recover (case of Cordery, Burnham, March, 1863). The practitioner who prescribed the morphine alleged that he had given only half a grain, but the facts of the case were adverse to this statement. No morphine was detected in the stomach. The fourth case occurred at the Middlesex Hospital in 1863. One-third of a grain of morphine was injected at night under the skin. In two hours the injection of a similar quantity was repeated. On the next morning another third of a grain was injected. The man slept quietly for two hours. He then took some dinner, and talked in his usual way; but in another hour he became almost suddenly insensible, and in two hours he died, the narcotic symptoms being most powerfully developed.

Sir Thos. Stevenson met with a case in which two doses, each of half a grain of hydrochlorate of morphine, taken internally, are supposed to have killed a hale man in middle life. Morphine was detected in minute quantity in the body after death. A case in which *one grain* of the acetate, dispensed by mistake in a pill, destroyed the life of a lady, is reported (*Pharm. Jour.*, July, 1872, p. 16). Narcotic symptoms came on in about half an hour, and she died in nine hours. In one case observed by Sir Thos. Stevenson a dose of twenty grains destroyed the life of a woman in about half an hour; and when subcutaneously injected the salts of morphine may kill in even a shorter time.

In perhaps no other drug (unless it be cocaine and tobacco) is the **influence of habit** so marked as in opium. Persons may by habit (opium eating) take enormous doses of opium with comparative impunity; and as much as half a pint of laudanum has been taken per diem for long periods. The dose required to kill an *habitué* of the drug cannot even be guessed at.

The **method of administration** has *per se* but little to do with the fatal dose, provided only that absorption can take place, thus:—

Poisoning by morphine not rarely occurs as the result of external application.

In 1867, a woman, suffering from cancer of the breast in a state of ulceration, applied to a druggist for some medicine to relieve pain. He applied at once *thirty grains* of morphine, covering with it the surface of the ulcer. The woman soon afterwards became insensible. When seen by a medical man she was quite unconscious; the pupils were contracted, the skin very cold, the pulse full and compressible. The woman was then in a hopeless state, and she died in ten hours after the application of the morphine to the breast. The jury returned a verdict of death from natural causes.

Anstey met with a case in which three grains of morphine given as an injection per rectum caused death in sixteen hours.

Death from the hypodermic injection of morphine salts is now a common occurrence, and one-fourth or even one-sixth of a grain may be fatal to an adult, according to the author's experience. It seems probable that Miss Hickman utilised this method in committing suicide in 1903, as a hypodermic syringe containing traces of morphia in it was found near her dead body, and Sir Thos. Stevenson extracted morphia from her viscera (*Med. Press*, November, 1903).

It has also been proved that morphia may be actually re-excreted *into* the stomach after it has been absorbed from it.

Duration.—Having no local irritant action, the symptoms only occur after some of the poison has been absorbed. Hence it is easy to understand the great variation in the time of onset.

The symptoms usually *commence* in from *half an hour* to *an hour* after the poison has been swallowed. Sometimes they come on in a few minutes, especially in children, and at other times their appearance is protracted for a long period. When morphia is hypodermically injected, symptoms appear within three or four minutes. In a case reported by Skae, the person was found totally insensible in *fifteen minutes*. As we might expect from the facts connected with the absorption of poisons, when the drug is taken in the *solid* state, the symptoms are commonly more slow in appearing than when it is *dissolved* in water or alcohol. In a case which occurred at Liverpool in 1863, a lady took on an empty stomach a large dose (supposed to have been one ounce and a half) of laudanum. No symptoms of narcotic poisoning appeared for four hours and a half, and life was protracted for twenty-two hours.

Most cases of poisoning by opium prove fatal in from about six to twelve hours. Those persons who recover from the stupor, and survive longer than this period, generally do well; but there may be a partial recovery, or a remission of the symptoms, and afterwards a fatal relapse.

In 1843, a gentleman swallowed a quantity of laudanum, and was found labouring under the usual symptoms. The greater part of the poison was removed from the stomach by the pump, and he so far recovered from his insensibility as to be able to enter into conversation with his medical attendants; but a relapse took place, and he died the following night. [Such cases are not uncommon, and danger cannot be considered to be absent for at least twenty-four hours.—Ed.]

The Hon. Mrs. Anson (January, 1859) swallowed, while fasting, an ounce and a half of laudanum by mistake. In a quarter of an hour emetics were given, but she did not vomit for half an hour; and she was not treated medically for two hours and a half. The matter then drawn from the stomach had no smell of laudanum. She was quite unconscious, and had lost the power of swallowing. After remaining in this comatose state for upwards of nine hours, the patient revived. The face became natural, the pulse steady. The power of swallowing returned. She was able to recognise her daughters, and, in a thick voice, to give an account of the mistake she had made. This state lasted about five minutes; the torpor then returned. She again sank into profound coma, and died in fourteen hours after the poison had been taken.

The symptoms, however, generally progress steadily to a fatal termination; or the stupor suddenly disappears, vomiting ensues, and the person recovers. Several instances are recorded of this poison having destroyed life in from seven to nine hours. One occurred within the author's knowledge in which an adult died five hours after taking the drug. Christison met with a case which could not have lasted above five, and another is mentioned by him which lasted only three hours. Barwis met with a case of an adult which proved fatal in three hours and a half. Nearly two ounces of laudanum had been taken; but there was no smell of opium in the stomach when inspected thirty hours after death. One case proved fatal in two hours and a half (Beck, "Med. Jur.," p. 873). Procter communicated to the author the case of a female, æt. 50, who swallowed an ounce of the pharmacopœial tincture, and died from the effects in less than *two hours*. Opium was found in the stomach. One of the most rapid cases of death yet reported was that of a soldier who was accidentally poisoned in the hospital of Val-de-Grâce. It appears that he swallowed by mistake about an ounce of laudanum, and it is stated that he died in convulsions in *three-quarters of an hour* (*Jour. de Méd.*, October, 1846, p. 475. For a similar case, see *Med. Gaz.*, vol. 45, p. 743). It is possible that the drug may destroy life even with greater rapidity than this; but, as a medico-legal fact, we are at present only entitled to state that it has destroyed life within the short period above mentioned. On the other hand, the cases are sometimes much protracted. There are several instances of death in fifteen or seventeen hours; and among those collected by Christison the longest lasted twenty-four hours.

[Rarely an unusual period elapses between the taking of the poison and the manifestation of narcotic symptoms. Christison mentions a case in which the stage of excitement lasted eighteen hours before somnolence set in ("On Poisons"). In another case, which proved fatal, the interval was fourteen hours (*B. M. J.*, March 20th, 1868).]

Symptoms.—The symptoms which manifest themselves when a large dose of opium, its tincture, or any of its preparations has been taken, are in general of a uniform character, but now and then very anomalous symptoms occur, due no doubt to the various alkaloids and other bodies which have been extracted from raw opium and investigated in recent years with great care. A condition of pleasurable mental excitement, usually of very short duration, is experienced. The period of excitement is followed by weariness, headache, incapacity for exertion, a sense of weight in the limbs, diminution of sensibility, giddiness, drowsiness, a strong tendency to sleep, and stupor succeeded by perfect insensibility, the person lying motionless, with the eyes closed as if in a sound sleep. In this stage he may be roused by a loud noise, and made to answer a question; but he speedily relapses into stupor. In a later stage, when coma has supervened with stertorous breathing, it will be difficult, if not impossible, to rouse him. The pulse is at first small, quick, and irregular, the respiration hurried, the skin warm and bathed in perspiration, sometimes livid; but when the person becomes comatose, the breathing is slow and stertorous, and the pulse slow and full. The skin is occasionally cold and pallid. The pupils in the early stage are contracted; in the last stage, and when progressing to a fatal termination, they may be found dilated. In a case referred to the author in 1846, one pupil was contracted, and the other dilated. They are commonly insensible to light. The expression of the countenance is placid, pale, and ghastly; the eyes are heavy, and the lips are livid. Sometimes there is vomiting, or even purging; and if vomiting takes place freely before stupor sets in, there is great hope of recovery. This symptom is chiefly observed when a large dose of opium has been taken; and it may then be, perhaps, ascribed to the mechanical effect of the poison on the stomach. [Or to alkaloids in opium other than morphine, though on some people morphine itself acts as an emetic.—Ed.] The odour of opium is occasionally perceptible in the breath. Nausea and vomiting, headache, loss of appetite, and lassitude, often follow on recovery. In cases likely to prove fatal, the muscles of the limbs feel flabby and are relaxed, the lower jaw drops, the pulse is feeble and imperceptible, the sphincters are relaxed, the pupils are unaffected by light, the temperature of the body is low, there is a loud mucous rattle in breathing, and convulsions are sometimes observed before death, but more commonly in children than in adults. One of the marked effects of this poison is to suspend all the secretions, except that of the skin. Even during the lethargic state, the skin, although cold, is often copiously bathed in perspiration. The **contracted state of the pupils** has been considered to furnish a valuable distinctive sign of poisoning by opium or the salts of morphine. In relying upon it, it is necessary to bear in mind the fact, pointed out by Wilks, that, in apoplexy seated in the Pons Varolii, the pupils are also contracted. He describes two cases of this form of apoplexy which were mistaken for poisoning by opium in consequence of this state of the pupils (*Med. Times and Gaz.*, 1863, 1, 214). In carbolic acid poisoning the pupils are much contracted, though seldom so minutely as in opium poisoning; and there is coma and stertorous breathing. As a rule the peculiar odour of carbolic acid in the breath will prevent any mistake as to the nature of such a case. The condition of the pulse varies greatly. It has been found small and feeble, sometimes full and slow. In some cases there is great irritability, as well as itching of the skin and irritability oı the bladder, with difficulty of passing urine. Vomiting and purging have been met with in those instances in which the dose was large. In one case of morphine poisoning, an apothecary was able to walk for an hour and a half after taking seventy-five grains of hydrochlorate of morphine (Hay's *Amer. Jour.*, October, 1862).

Idiosyncrasy has something to do with the exact nature of the symptoms. The editor knows personally several people, and has met with many more in practice, in whom the smallest dose of opium or morphia produces severe vomiting, and in himself it causes the most violent abdominal pain, lasting half an hour or so, with very slight tendency to sleep.

It has been stated that opium in large doses may sometimes operate not as a narcotic, but as a stimulant to the nervous centres, causing violent convulsions. In some instances the convulsions are said to have assumed a tetanic character, resembling those caused by strychnine. This is stated to have been noticed where the alkaloid or its salts had been used hypodermically. It has been alleged that the tetanic symptoms of strychnine are not to be distinguished from those caused by large doses of morphine. One medical authority announced that all the symptoms assigned to poisoning by strychnine in Cook's case (*R.* v. *Palmer*) might be explained by supposing that he had taken three grains of morphine. [Considering that upwards of 12 or 15 alkaloids and analogous bodies have been extracted from opium and that the actions of some of these are distinctly convulsant there is no difficulty in accepting the above statement as representing an exceptional case in which the victim was peculiarly sensible to the convulsant bodies in opium, so that their action overcame that of the morphia. Such a possibility need not offer any forensic difficulty now the extractives of opium are better understood.—Ed.]

In compound poisoning, where laudanum is one of the ingredients, it may be expected that symptoms of narcotic poisoning will show themselves. In one case a woman, æt. 22, swallowed a packet of

Battle's "Vermin Killer," and immediately afterwards two drachms of laudanum, and then half a drachm of red precipitate. In three hours she was found to be suffering from narcotic poisoning alone. None of the effects of strychnine had been produced, and there was no irritation from the mercurial poison. Emetics were given, and the stomach-pump used. By this a quantity of Battle's powder and red precipitate were removed from the stomach. Albumen was given, and the woman slowly recovered (*Lancet*, 1871, 2, p. 907). It was inferred that the opium had here prevented the action of strychnine. It would have been more satisfactory if the powder drawn from the stomach had been examined, and strychnine found in it, as opium is not an antidote for strychnine (*vide* p. 338). There were no symptoms of poisoning by strychnine at any time, although three hours had elapsed before remedies could be applied. Vomiting is an occasional symptom which may come on soon after the poison has been taken; so also may itching of the skin, with a rash.

Treatment.—If the poison was swallowed the stomach-pump should be used, and the stomach well washed out; this should be done repeatedly, owing to the fact that morphia after absorption is re-excreted into the stomach. In default an emetic may be administered by the mouth, or apomorphine may be injected subcutaneously. Persevering attempts are to be made to rouse the patient by external stimulation; the faradaic current, applied to various parts of the body with a wire brush, is an efficacious stimulant: walking the patient to and fro between two assistants may be resorted to, but only in the less severe forms of poisoning. When the coma is profound, artificial respiration may be needed; this constitutes a most *valuable aid to recovery;* it may be supplemented by faradaic stimulation of the phrenics. Ammonia may be applied to the nostrils in the form of smelling-salts. The vapour of ammonia water should not be used; it is too irritating to the respiratory mucous membrane. Hot coffee may be given by the mouth if the patient can swallow; if not, it may be administered by the stomach-pump or as an enema. One-twentieth of a grain of atropine sulphate, injected hypodermically and repeated if necessary, is recommended for the purpose of stimulating the respiratory centres, but its utility is doubtful, notwithstanding the number of successful cases in which it has been used (see section on "Antagonism of Poisons"). Hypodermic injections of ether are efficacious. Strychnine is strongly advocated by some. Lucatello had a case in which a patient swallowed about forty-five grains of opium and twenty-two grains of morphine sulphate on an empty stomach. Symptoms did not appear for an hour. Breathing having nearly ceased, artificial respiration, and faradaisation of the phrenics, were resorted to, but without effect; under the influence of hypodermic injections of strychnine, respiration was resumed.

In cases which are not very severe, the cold douche and perambulating the patient may be sufficient, but the former should never be used when the surface is cold, nor should the latter be carried to excess, so as to exhaust the strength. *In severe cases it is worse than useless to drag a comatose individual about* (Mann).

In 1895, Dr. Moor, of New York, published a paper stating that permanganate of potassium was a complete antidote to morphine when mixed in organic liquids. This paper attracted the attention of Dr. Luff, and he published in the *B. M. J.*, 1, 1896, p. 1193, an account of some experiments he made on the subject, which are of sufficient importance, coming from so high an authority, to deserve further recognition. Dr. Luff writes :—

"The following is a brief description of the method employed in each experiment: A known quantity of a morphine salt in solution was mixed with vomit, and after thorough agitation a known quantity of potassium permanganate in solution was added, and the mixture agitated at intervals for half an hour. It was then mixed with alcohol acidulated with acetic acid, filtered through linen, and the filtrate evaporated at 35° C. to a syrup ; the syrupy residue was extracted with successive quantities of absolute alcohol, which were filtered, and the alcohol evaporated off; the residue was then extracted with water acidulated with acetic acid, which would dissolve out any morphine, and the acidulated liquid was filtered; the filtrate was rendered alkaline with ammonia and then shaken with twice its volume of hot amylic alcohol, which, after separation, was removed, and the extraction with amylic alcohol repeated a second and third time; the amylic alcohol extracts were mixed, filtered, and evaporated to dryness over a water bath. The residue was then dissolved in a little water acidified with acetic acid, the solution filtered, concentrated, and a slight excess of ammonia added ; it was then allowed to evaporate spontaneously, and the residue was carefully examined for morphine.

"*Experiment I.*—Five grains of morphine acetate were mixed with ℥ijss. of vomit, and eight grains of potassium permanganate dissolved in ℥viij. of water added. No morphine could be extracted from the mixed substances.

"*Experiment II.*—Five grains of morphine acetate were mixed with ℥iij. of vomit, and seven grains of potassium permanganate dissolved in ℥ viij. of water added. No morphine could be extracted from the mixed substances.

"*Experiment III.*—Three grains of morphine acetate were mixed with ℥iv. of vomit, and four grains of potassium permanganate dissolved in ℥iv. of water added. No morphine could be extracted from the mixed substances.

"*Experiment IV.*—Three grains of morphine acetate were mixed with ℥vj. of vomit, and four grains of potassium permanganate dissolved in ℥iv. of water added. No morphine could be extracted from the mixed substances.

"These experiments demonstrate the selective faculty of the permanganate for morphine in the stomach contents, and confirm Moor's conclusions as to the value of potassium permanganate as an antidote for opium and morphine poisoning. When the quantity of morphine that has been taken is known, I should advise the administration of a quantity of potassium permanganate slightly in excess of the morphine; if it is laudanum that has been taken, and the quantity is known, six grains of potassium permanganate should be administered for each fluid ounce of laudanum taken. If in any case the quantity of morphine or opium taken is unknown, from eight to ten grains of the permanganate should be administered according to the severity of the symptoms.

"It should be given dissolved in from four to eight ounces of water. The stomach should afterwards be washed out two or three times, at intervals of half an hour, with a weak solution of permanganate, in order to decompose the morphine that has been absorbed and that is being excreted into the stomach. In cases of poisoning by the hypodermic injection of morphine, I do not think that the hypodermic injection of the permanganate would be of any use, but the washing out of the stomach with the weak solution of the permanganate should certainly be resorted to. In cases of threatened respiratory failure strychnine or atropine (the former preferably) should be administered hypodermically, in order to stimulate the respiratory centre, and artificial respiration should be resorted to if necessary."

On the next page to Dr. Luff's article in the *B. M. J.* is another article by Dr. F. P. Maynard, who in India had very large opportunities of investigating the question. He refers to the mode of action, and, while agreeing with Luff in general terms, he doubts if the permanganate can be of much use either when the morphia has been injected subcutaneously, or when the permanganate is so administered. He sums the matter up thus :—

"Permanganate of potassium is a strictly local antidote. It can only act upon such opium as it comes into contact with in the stomach, and can have no effect upon such as has already been absorbed. That it oxidises morphine re-excreted into the stomach does not affect this statement. The treatment is excellent as leading to thorough washing out of the stomach and at the same time affording a reliable indication when this is accomplished; but it is not to be expected that it will save life where a lethal quantity has already been absorbed into the circulation, nor can permanganate be regarded as a physiological antidote to opium such as eserine is to atropine.

"This conclusion is opposed by Moor, and would appear to be too absolute, to judge by the following case of an infant in a state of profound opium narcosis, due to an overdose of 'soothing' syrup. After failing to produce any alleviation of the symptoms by four hours' active treatment, as a last resource five minims of saturated solution of permanganate of potassium were injected into the thigh. In an incredibly short time all the alarming symptoms subsided, respiration improved, and consciousness quickly returned" (*Therap. Gazette*, March 15th, 1895).

Dr. Moor's original article was reproduced in the *B. M. J.*, 1, 1895, p. 1369.

Post-mortem Appearances.—There is absolutely nothing characteristic unless it be the smell of opium in the stomach contents. With morphia this is of course not present. In a case which proved fatal in fifteen hours, the vessels of the head were found unusually congested throughout. On the surface of the fore part of the left hemisphere of the brain there was an ecchymosis, apparently produced by the effusion of a few drops of blood, and there were numerous bloody points on its cut surface. There was no serum collected in the ventricles. The stomach was healthy. Fluidity and a dark colour of the blood are mentioned as common appearances in cases of poisoning by opium. There is also engorgement of the lungs, most frequently observed, according to Christison, in those cases which have been preceded by convulsions (*op. cit.* p. 732). Among the external appearances there is often great lividity of the skin. Extravasation of blood on the brain is rarely seen; serous effusions in the ventricles, or between the membranes, are sometimes met with. The stomach is so seldom found otherwise than in a healthy state, that the inflammatory redness said to have been occasionally seen may have been due to accidental causes. When tincture of opium has been taken and retained in the stomach, increased redness of the mucous membrane may be produced by the alcohol alone. In a case of poisoning by a large dose of tincture of opium, the following appearances were found twelve hours after death:—The body was warm and rigid, and the stomach healthy, containing a quantity of gruel-like fluid, without any smell of opium. The intestinal canal and all the other viscera were healthy. The veins of the scalp, as well as of the dura mater and sinuses, were gorged with blood; but there was no effusion in any part of the brain. The contents of the stomach yielded no trace of morphine nor of meconic acid, but there was no doubt that death had been caused by opium, taken on the previous night (*Med. Gaz.*, vol. 37, p. 235). A case was the subject of a trial at the Aberdeen Autumn Circuit, September, 1853, in which a child, aged six months, died in a few hours from a dose of sixty drops of wine of opium. The brain was congested to a marked extent. Although the dose was comparatively large, and death rapid, there was no decided indication of the presence of opium in the stomach.

Chemical Analysis.—*Opium.*—There are no means of detecting opium itself, either in its solid or liquid state, except by its smell and other physical properties, or by giving a portion of the suspected substance to animals and observing whether any narcotic effects are produced. The smell is said to be peculiar, but a similar smell is possessed by lactucarium (p. 753), which contains neither meconic acid nor morphine. The odour is a good concomitant test of the presence of the drug, whether it be in a free state or dissolved in alcohol or water, but it is not perceptible when the solution is very much diluted, and it loses its characteristic smell by exposure. The odour passes off when an opiate liquid is heated; it also escapes slowly at common temperatures. Again, it may be concealed by other odours, or the drug may undergo some change in the stomach during life that may rapidly destroy the odour. The analysis in cases of poisoning by opium is therefore limited to the detection of morphine and other alkaloids and the meconic acid with which the morphine, etc., may be combined.

Morphine.—Morphine may be identified by the following properties:—(1) It crystallises in fine white prisms. These crystals may be obtained by adding weak ammonia to a solution of morphine in hydrochloric acid. (2) When heated on platinum, the crystals melt, become dark-coloured, and burn like a resin with a yellow smoky flame, leaving a carbonaceous residue. If this experiment is performed in a small reduction tube, it will be found, by employing test-paper, that ammonia is one of the products of decomposition. (3) It is scarcely soluble in cold water, as it requires 1,000 parts to dissolve it; it is soluble in 100 parts of boiling water, and the hot solution has a faint alkaline reaction. By its insolubility in water, the base is readily distinguished from its salts. It is very slightly soluble in ether, thus differing from narcotine; but it is dissolved by forty parts of cold alcohol, and rather less than this quantity of boiling alcohol. It is dissolved by a solution of potash or soda, in which narcotine is insoluble, and from this solution morphine cannot be completely removed by ether. It is soluble in acetic ether and in amyl-alcohol, and these have been employed as substitutes for ether in procuring morphine from organic liquids. (4) It is easily dissolved by a very small quantity of all diluted acids, mineral and vegetable. (5) Morphine and its solutions have a bitter taste. (6) The salts of morphine are not precipitated in a crystalline form by solutions of sulphocyanide of potassium, ferrocyanide of potassium, or of chromate of potassium. In this respect they are strikingly distinguished from the salts of strychnine, which give well-marked crystalline precipitates with these three reagents.

The following chemical tests for morphine are most definite when applied to the cold, dry, solid:—(1) *Nitric Acid.* Add one or two drops of the strong acid to a fragment of the solid. The morphine is entirely dissolved and the solution acquires a deep orange-red colour. Warm this solution till the red colour turns yellow, dilute with a little warm water and add gradually a fresh solution of sodium thiosulphate; the colour does *not* change to violet (distinction from brucine). (2) *Iodic Acid with Chloroform.* A drop of solution of iodic acid should be mixed with twice its volume of chloroform. There should be no change of colour. On adding a small quantity of these mixed liquids to morphine or its salts, either solid or in solution, the iodine is separated from the iodic acid and dissolved by the chloroform, which sinks to the bottom, acquiring a pink or red colour, varying in its intensity according to the quantity of morphine present. The presence of morphine may be thus easily detected in one drop of the tincture of opium, in chlorodyne or other opiate liquids, in spite of the presence of organic matter. If chloroform is not used, iodine may be detected by the blue colour produced on the addition of a solution of starch. The colour is discharged by solution of ammonia, and the supernatant aqueous liquid acquires a brown colour. No reliance can be placed on the liberation of iodine alone. (3) *Sulpho-molybdic Acid.* Dissolve, with a gentle heat, five or six grains of powdered molybdic acid in two drachms of strong sulphuric acid, and cool. The liquid should be freshly prepared, and kept from contact with air and organic matter. When one or two drops are rubbed with dry morphine or any of its salts an intense reddish purple or crimson colour is produced. This changes to a dingy green and ultimately to a splendid sapphire blue. A minute trace of morphine is thus revealed. This test produces no change in *strychnine*, but the mixture slowly acquires a pale blue tint. The presence of morphine in strychnine is thus easily detected. When poured on *brucine* this acquires a rose-red colour, becoming greenish brown and ultimately dark blue. When mixed with *veratrine* the liquid becomes greenish brown, and gradually passes to a darker shade. The margin becomes purple, and ultimately the whole mixture acquires a deep blue colour. On hydrate of chloral sulphomolybdic acid produces no change. (4) *Sulphuric Acid and Bichromate of Potassium.* When strong sulphuric acid is poured on pure morphine in a solid state, there is either no effect, or the alkaloid acquires a light pinkish colour. On adding to this a drop of solution of bichromate of potassium, or a small fragment of a crystal, it immediately becomes green (from the production of chromic oxide), and retains this colour for some time. Other alkaloids (strychnine) are not thus affected. Narcotine is turned a bright yellow by sulphuric acid; therefore, although it becomes green when mixed with bichromate of potassium, it could not be mistaken for morphine: besides, the green rapidly passes to a dingy brown colour. (5) *Iron Test.* A drop of a solution of ferric chloride added to a fragment of morphine produces a blue colour. (6) *Phospho-molybdic Acid*—a useful group reagent for vegetable alkaloids—gives with morphine solutions the usual yellowish precipitate, but this precipitate dissolves in excess of ammonia to a deep blue solution (distinction from brucine, strychnine, cocaine).

Meconic Acid.—This is a solid, colourless, crystalline acid. It is combined with morphine in opium, of which it forms on an average 8 to 10 per cent.; and it serves to render this alkaloid soluble in water and other menstrua. *Tests.*—There is only one test upon which any reliance can be placed, namely, *ferric chloride* or *ferric sulphate.* This test produces, even in a diluted solution of meconic acid, a deep blood-red colour; and it is owing to the presence of this acid that a salt of iron strikes a red colour in tincture and infusion of opium as well as in all liquids containing traces of meconate of morphine, the effects of the iron test with morphine being counteracted by the presence of meconic acid. The red colour of ferric meconate is not easily destroyed by diluted mineral acids (distinction from ferric acetate), nor by a solution of corrosive sublimate (distinction from ferric sulphocyanide), but it is by sulphurous acid and stannous chloride. In liquids containing tannic acid, *e.g.*, tea or beer, the action of this test is obscured by the production of ferric tannate. The dark colour is removed by a few drops of diluted sulphuric acid.

Detection of Opium in Organic Mixtures.—Opium itself may be regarded as an organic solid, containing the poisonous salt which we wish to extract. It is not always that in fatal cases of poisoning with opium or its tincture, even when these are taken in large quantity and death is speedy, we can succeed in detecting meconate of morphine in the stomach. It is probably removed by vomiting and by absorption. If the matter is solid, it should be cut into small slices; if liquid, evaporated to an extract; and, in either case, digested with a large quantity of rectified spirit, slightly acidulated with acetic acid. The residue should be well pressed in linen; the alcoholic liquid should then be evaporated at a low temperature until it is dry. The residue should be digested in absolute alcohol, filtered, and the filtrate evaporated to dryness as before. The residue is to be taken up with water, filtered, and treated with acetate of lead until there is no further precipitation. This liquid should be warmed and filtered; meconate of lead is left on the filter, while any morphine passes through. The surplus acetate of lead contained in the filtered liquid (containing the morphine) should now be precipitated by a current of sulphuretted hydrogen, the sulphide of lead separated by filtration, and the liquid evaporated at a very gentle heat, so that any sulphuretted hydrogen may be entirely expelled. On treating this extract with alcohol the acetate of morphine, if present, will be dissolved. The alcoholic liquid is again evaporated and taken up by water. On evaporating a drop or two of the watery liquid with a drop of freshly prepared solution of starch, and touching the residue with a drop of a solution of iodic acid, morphine will reveal itself by the production of a blue colour. Other tests may also be applied to the solution.

The lead *meconate* left on the filter is readily decomposed by warming it with a small quantity of diluted sulphuric acid; and in the filtered liquid, neutralised if necessary by an alkali, the meconic acid is detected by the ferric chloride test. A current of sulphuretted hydrogen may be used in place of sulphuric acid. The sulphide of lead takes down with it much of the organic matter of the precipitate. This analysis requires care as well as some practice in the operator, in order that the morphine should be obtained in a sufficiently pure state for the application of the tests.

Before resorting to this process it is advisable to employ *trial tests* on the original liquid, in order to determine whether any meconic acid or morphine is present or not. The smell of opium may be entirely absent. Meconic acid may be readily detected by the action of a ferric salt on the diluted organic liquid, and morphine may be found by adding to a portion of the liquid a mixture of iodic acid and chloroform. The chloroform acquires a pink colour by dissolving the iodine set free by morphine or its salts. These tests may be equally applied to a solution of opium obtained by dialysis. The following confirmatory test for meconic acid is published in the *Lancet*, 1, 1904, by Dr. Windsor:—

In performing the ferric chloride test a "control" is always carried out with distilled water equal in volume to that of the suspected liquid. This volume is usually about three drachms, and test-tubes of small calibre are used to obtain as long a column as possible to look through. Two drops of ferric perchloride solution (B.P.) are added to each tube, and the colours are compared. If the reddish tint of the suspected liquid be not distinct, then one drachm from the contents of each tube is boiled for thirty seconds. In each case the colour changes to a deep reddish brown. If to each of the hot solutions four drops of dilute nitric acid (strength one in five) or dilute hydrochloric acid (strength one in seven), preferably the former, be added, the colour of the ferric meconate solution fades until in twelve hours the solution is colourless, while that of the ferric perchloride (in which is a soluble hydroxide) is little or not at all affected.

Cases.—The following case is an illustration of the unfortunate results of putting preparations of opium into ordinary bottles. It is typical of the way in which accidents arise, and therefore worth recording, though it is doubtful what share the opium actually had in causing death.

The Manchester city coroner held an inquiry on June 24th, 1898, into the circumstances attending the death of Frances Atkins. It was stated in evidence that the resident medical officer had ordered a mixture of chloral and bromide for deceased, but the nurse in charge had given the woman half an ounce of Battley's liquor opii sedativus instead. She discovered her mistake immediately afterwards, and at once informed the doctor, who applied the stomach-pump, but in spite of every effort the woman died next morning. The consulting physician at the workhouse, who had made a post-mortem examination, gave it as his opinion that sufficient Battley's solution to cause death could not have been absorbed in so short a time. Death was due to cerebral hæmorrhage. It was out of the question to discover whether death was accelerated by the Battley's solution, the woman not only being out of her mind, but also being a mass of disease (*Chemist and Druggist*, July 2nd, 1898).

In the following case recovery must be attributed to the permanganate, for sixteen grains would otherwise have inevitably killed:—

"About eight o'clock on the evening of August 3rd, 1895, I was hurriedly called to see a patient who was reported to have been suddenly taken ill. On my arrival I found him in a semi-comatose condition, though still capable of being slightly roused. The skin was cold and clammy, the pupils contracted so as to be almost invisible. The pulse was rapid, soft, and compressible. The respirations were shallow, but not materially altered in number, and there was suppression of urine.

"A bottle lay on the table, marked 'Poison,' but had no distinctive label; it contained a small quantity of nearly colourless liquid, which I afterwards ascertained to be a very strong solution of morphine. (He admitted to me after his recovery that he had taken the drug about an hour and a half before I saw him, and the quantity taken would represent over sixteen grains of the sulphate.) When I saw him, however, there was no mistaking his symptoms. From the condition in which I found him, and from the excessive overdose of the drug, I felt that it would be useless to trust to belladonna; and having ascertained that his stomach was practically empty, I determined to adopt the treatment recommended by Dr. William Moor, reported in the *B. M. J.* of June 22nd, 1895, and accordingly, with considerable difficulty, got him to swallow five grains of permanganate of potash dissolved in half a pint of water. I then had the man placed on his feet and supported between two attendants, who moved him gently about.

"In about half an hour after swallowing the solution he vomited, and in a few minutes after I repeated the dose. He appeared a little more sensible after vomiting, but I had considerable difficulty in keeping him awake, and his pulse grew so faint that for some time I feared that all efforts would be useless. Hypodermic injections of strychnine, however, had a marvellous effect in strengthening the heart's action.

"Three doses of permanganate solution (five grains in each) were administered in all. Vomiting occurred in about half an hour after each dose, and this was followed by marked improvement. I remained with him until six o'clock next morning, when all immediate danger appeared to be over, and he subsequently made a rapid recovery.

"This case illustrates the marvellous affinity which permanganate of potash has for morphine, even when it has been absorbed into the system, as in this case. Morphine is well known to be largely excreted by the mucous membranes of the stomach, and the administration of the permanganate accelerates its elimination by that organ, the alkaloid being rapidly taken up and oxidised by the permanganate.

"Another important fact is elicited from this case, that is, that, though the morphine be absorbed into the system, it is not absolutely necessary to administer the antidote hypodermically. One grain of permanganate oxidises one grain of morphine, and when a large dose of the poison has been taken, as in the above case, it would be obviously unsafe to administer the requisite amount of the antidote hypodermically. In addition, permanganate of potash produces very unpleasant symptoms when administered subcutaneously, as well as causing a good deal of local irritation" (*B. M. J.*, 1, 1896, p. 82).

POISONING BY PHYSOSTIGMA VENENOSUM.

Source and Method of Occurrence.—The calabar bean is a large leguminous seed of a dark colour, resembling a garden bean, but much thicker and more rounded in its form. It is brought from the western coast of Africa, and is there employed by the natives as an ordeal bean when persons are suspected of witchcraft. The common belief is, that the innocent vomit and are safe, while the guilty retain the poison and die from its effects. So strong is popular confidence in this test, that those who are suspected voluntarily take an emulsion of this seed, and, as Christison remarks, many an innocent person thus pays the penalty of his rash reliance on this superstitious custom. It is a firm matter of faith that if a man dies he is guilty.

The seed or bean has a thin, hard, dark-coloured, brittle covering; the kernel inside is white, and weighs from thirty-six to fifty grains, the whole seed about sixty-seven grains. This bean owes its properties to the presence of an alkaloidal substance called *physostigmine* or *eserine*, which is found in the cotyledons. Christison found that the active principle could be extracted by alcohol, which dissolves 2·7 per cent. of the seed, including this substance. The greater part of the seed, as in nux vomica, consists of starchy and other inert matters, with a small quantity of oil. The kernel is yellowish white, without bitterness, acrimony, aroma, or any distinct impression on the organ of taste. In fact, it cannot be distinguished by taste from a haricot bean.

In the form of a pure solution of a salt of eserine the drug is now largely used in ophthalmic practice in the form of lamellæ, each containing $\frac{1}{1000}$ grain of eserine sulphate. There is also an official extract, dose $\frac{1}{4}$ to 1 grain.

The drug has not hitherto been used for homicidal purposes, accident and one suicide accounting for all the cases.

Toxicity and Fatal Dose.—Eserine paralyses the motor nerves, and leaves the intellect and muscular irritability unimpaired. It destroys life by paralysing the respiratory muscles, and although it weakens the heart's power, it neither stops the circulation nor arrests the heart's action. It is not, according to Harley, a cardiac, but a respiratory poison. It is closely allied in its effects to curare and conine, but more to the latter. It differs from both in its tendency to produce muscular twitchings, and in its power of causing contraction of the pupil. Neither curare nor conine has any effect on the pupil (*Lancet*, 1863, 1, p. 717).

A drop of a solution of eserine applied to the eye produces in from ten minutes to a quarter of an hour a remarkable contraction of the pupil. This has been observed to last in children for fifteen or twenty hours. In this respect the poison is eminently distinguished from the three natural mydriatic alkaloids, atropine, hyoscyamine, and hyoscine, which cause great dilatation of the pupil. It causes contraction of the pupil when taken internally, as well as when applied locally.

The special character of poisoning by calabar bean consists mainly in a diminution of the excitability, and paralysis of the peripheral nerves, and paralysis of the excito-motor centres of the heart and their peripheral endings, also in producing contraction of the vessels and of the unstriped muscles, especially those of the intestine and the sphincter muscles of the iris, as well as in promoting salivary and other secretions. It has but little, if any, action on the brain cortex, as evidenced by the retention of consciousness until failing cardiac and respiratory activity produces coma by stagnation of the blood.

Sir Thos. Stevenson has himself observed very marked diminution of respiratory depth from the hypodermic use of salts of eserine.

Six beans have proved fatal.

Symptoms.—Desiring to try the effects of this seed on himself, Christison took the eighth part of a seed, or six grains, one night before going to bed. There was a slight sense of numbness in the limbs during the night, but in the morning no urgent symptoms of any kind. He then chewed and swallowed the fourth part of a seed (twelve grains). In twenty minutes he was seized with giddiness, and a general feeling of torpor over the whole frame. He immediately swallowed an emetic, and thus emptied his stomach. The giddiness, weakness, and faintness increased to such a degree, that he was obliged to lie down in bed. In this state he was seen by two medical friends, who found him prostrate and pale, the heart and pulse extremely feeble and tumultuously irregular, the mental faculties intact, extreme faintness threatening dissolution, but no apprehension of death on the part of the patient. There was no uneasy feeling of any kind, no pains nor numbness, no prickling, not even any sense of suffering from the great feebleness of the heart's action. There was the will but not the power to vomit; the limbs became chill, with a vague feeling of discomfort. Stimulants were employed, and warmth and pulsation, with a power of moving, gradually returned. Two hours after the poison had been taken he felt drowsy, and slept for two hours more, but with such activity of mind that he had no consciousness of having been asleep. The tumultuous action of the heart continued. After this the symptoms gradually disappeared, and the next day he was quite well (*Pharm. Jour.*, 1855, p. 474).

In 1864, fifty children were poisoned at Liverpool by reason of their having eaten these beans. The sweepings of a ship from the west coast of Africa had been thrown on a heap of rubbish; the children found the beans and ate them. A boy, æt. 6, who ate six beans, died in a very short time. The principal symptoms were severe griping pains, constant vomiting, and contracted pupils. In addition to these symptoms, the face was pale, and the eyes were bright and protruding. In attempting to walk, the children staggered about as if they were drunk. In 1864, two children, aged six and three years respectively, chewed and ate the broken fragments of the kernel of one nut. In about forty minutes they complained of sickness. One child held his head drooping, appeared sleepy, and his hands were powerless. He staggered, and was scarcely able to walk. He complained of severe pain in the stomach, and made ineffectual attempts to vomit. Milk was given, and he then vomited. The child became quite prostrated, the pulse was feeble and slow, and the pupils were slightly contracted. Some pieces of the nut were thrown up by the vomiting. The other child had pain in the abdomen, and was listless, sleepy, and depressed. He vomited freely, some portions of the nut being ejected. He could neither stand nor walk. His face was pale, the eyes were piercing, but the pupils and pulse were natural. In this case there was purging. The children recovered on the third day (*Edin. Month. Jour.*, 1864, p. 193). In cases in which it has proved fatal to animals it has caused much irritation and congestion of the stomach and bowels (Dragendorff).

Frazer relates the case of two maidservants who were poisoned by tasting some of the embryos of the bean through curiosity (*Edin. Med. Jour.*, 1863, 2, p. 131).

African travellers have described the symptoms resulting from the use of the beans as an ordeal as consisting of violent thirst, inability to swallow, cramps, and muscular twitchings. If vomiting takes place, as it often does early when a large dose is given, recovery ensues rapidly, otherwise consciousness remains till shortly before death, which occurs usually within half an hour.

Post-mortem Appearances.—There are none peculiar to the plant unless it be the extreme contraction of the pupils. Judged from the case below, this might be absent, and then there only remains discovery of bits of the bean in stomach or vomit and the exact analysis.

Analysis.—Physostigmine (eserine) combines with acids to form salts. A solution of bromine in water acts in a characteristic manner on a solution of the sulphate, even when diluted to $\frac{1}{100000}$th part. It produces a red colour when less than $\frac{1}{1000}$th of a grain is present. Potassio-mercuric iodide also precipitates physostigmine. Phospho-molybdic acid gives with solutions of this alkaloid the usual yellowish precipitate, and this dissolves in ammonia to a deep blue solution as in the case of morphine. A drop or two of strong nitric acid added to the dry alkaloid strikes a gamboge colour, which changes to violet on addition of caustic potash. The physiological test consists in the application of a solution of eserine to the eye. It produces strong contraction of the pupil when this liquid contains but a minute proportion of physostigmine. It is rapidly eliminated by the saliva and other secretion (Husemann's *Jahresber.*, 1872, p. 570).

It may be extracted from organic material by the method described on p. 352 for alkaloids.

Cases.—The following case is taken from Mann's "For. Med.," p. 601, who quotes it from *Vierteljahrsschr. f. Ger. Med.*, 1892 :—

> "An unique case of suicidal poisoning with physostigmine is recorded by Leibholz. Two girls, aged twenty-four and eighteen respectively, obtained possession of a sealed tube containing 0·1 gramme of physostigmine sulphate, which they dissolved in water, and each girl drank half of the solution. For half an hour they pursued their household avocations without experiencing any effects; they then suddenly became unconscious. In each case the face was red and shining; the pupils, dilated to the maximum, were reactionless; the pulse, sixty to the minute, was full and of high tension; the respirations were shallow, rapid, and moaning; pain was experienced in the region of the stomach and abdomen; vomiting occurred early, and persisted for some time after return to consciousness. Dilatation of the pupils, with feeble reaction to light, lasted for several days, perfect recovery ultimately taking place. The activity of the alkaloid was vouched for by Merck after chemically examining a companion sample. Tested physiologically, three milligrammes injected under the skin of a rabbit weighing four pounds produced paralysis of the voluntary muscles, difficulty of respiration, violent diarrhœa, and death in ten minutes. A solution dropped into the human eye caused marked contraction of the pupil. The dilatation of the pupils in the above-recorded cases is remarkable. Cases of calabar bean poisoning have occurred without contraction of the pupils, but none with dilatation. The absence of diarrhœa is in marked contrast to its universal occurrence in animals poisoned with physostigmine."

Poisoning by Pinus (sp. var.), or Oil of Turpentine.

Source and Method of Occurrence.—The oil is distilled from the oleo resin, the natural exudation of the trees. The few cases in which oil of turpentine has produced fatal symptoms have occurred among children.

Camphine is oil of turpentine purified by distillation with lime. A woman, æt. 22, swallowed a large quantity of this liquid. She was soon seized with violent vomiting, which was increased by milk and other liquids. The matter vomited smelt strongly of turpentine. She was restless, and in great pain; there was some purging. There was not entire loss of consciousness. In two hours she felt cold, and the pulse was small and weak; the head then became hot, there was headache, but the pupils were unchanged; there was redness of the conjunctivæ. A quantity of urine was passed smelling of violets, and the breath also had a similar odour. There were some slight nervous symptoms, but these passed off. She recovered in eight days (Horn's *Vierteljahrsschr.*, 1866, 2, 337).

Toxicity and Fatal Dose.—Turpentine cannot be said to be very toxic. It may irritate the stomach as a primary effect, and after absorption it has a specific influence on the kidneys, causing irritation of them which may lead to inflammation. The editor is unable to find a recorded case of fatal poisoning by turpentine in an adult, so that the fatal dose must remain with the records (*infra*) in children.

It is to be noted, however, that the most dangerous doses of turpentine are the ones intermediate between the official two to ten minims and the anthelmintic dose of half an ounce. The former can be dealt with by the kidneys, and the latter is generally carried off by the purgation produced, but doses of one to two drachms are insufficient to purge, and may act very deleteriously upon the kidneys; indeed, a case of death from doses of one to two drachms was some few years ago the subject of a judicial inquiry, in which the medical man was severely blamed; the editor is unable, however, to find the record of the case.

Symptoms.—It appears to have rather the effects of a neurotic (narcotic) than an irritant poison. In a dose of three drachms it has produced intoxication. A dose of a tablespoonful caused in a child, aged eighteen months, symptoms bearing a strong resemblance to those occasioned by an overdose of opium, although they were not so rapidly manifested (see case *Med. Times*, 1851, 2, p. 380). In three hours there was complete insensibility, with stertorous breathing, strongly contracted pupils, rapid and weak pulse, coldness of the surface, paleness of the countenance, general relaxation of the muscles, and occasional convulsive movements. Two fatal cases are recorded. The first was the case of a child aged fourteen weeks. The child had had half an ounce of the oil poured down its throat by a brother, æt. 8. It had been left asleep at 9 p.m., and in an hour it was found to be insensible, cold, and slightly convulsed. At midnight it was seen by Miall. It was comatose, pale, with extremely cold surface, contracted pupils; slow and irregular breathing, about three times in a minute; pulse quick, small, compressible, almost imperceptible. A strong odour of turpentine issued from the mouth, and there was a spot of liquid on the pillow. The child was unable to swallow. It died in fifteen hours after taking the poison. In the second case the child was five months old. A spoonful of spirit of turpentine was given to it by mistake for peppermint, and death took place rapidly (*Pharm. Jour.*, July, 1872, p. 75).

Cases.—A case of recovery in an infant that had swallowed four ounces of the oil is described in another work ("On Poisons," p. 658). A case in which this liquid was criminally administered to an infant was the subject of a trial (C. C. C., December, 1856, *R.* v. *Rodanbosh*). It did not destroy life, but the child suffered for some time from the effects. The defence was, that the oil of turpentine was poured down the child's throat by the mother with a view to cure it of a cough. She was acquitted.

POISONING BY PRIMULA OBCONICA.

Source and Method of Occurrence.—This plant is not a native, but seems to be frequently grown in gardens and greenhouses. Some few years ago attention was drawn to the evil effects of handling it, and since then several cases of very severe illness from it have been reported. None of them, so far as the editor is aware, have been fatal. The following, reported by Dr. Leighton in the *B. M. J.*, 2, 1898, p. 1159, is a fairly typical though severe case:—

"In October, 1896, I was called to G. W., aged forty, head gardener on an estate near. I found him suffering from tremendous œdema of the right hand, with well-marked lymphangitis of right arm, and tenderness in axillary glands.

Next day there began a profuse serous discharge from several points on the back of the hand, and from between the second and third fingers. The pain in the joints was excessive, and the patient was slightly feverish. The discharge continued for eight days, gradually decreasing.

"In June, 1897, the patient had a similar attack, all the symptoms of the first being reproduced, only with less severity. This attack yielded to treatment in a week.

"In September, 1898, a third attack came on, this time in the right foot—pain, œdema, and slight serous discharge from dorsum of foot. The discharge was much less than in the two attacks in the hand, and on the fourth day the swelling had completely disappeared.

"*Diagnosis.*—When called in the first time I could discover no skin abrasion whatever, and inquiry failed to trace any of the usual causes of local blood poisoning. Careful questioning, however, disclosed the fact that a few days previously the patient had handled a number of plants of the *Primula obconica*. Those plants were subsequently banished from the greenhouses. In the second and third attacks there was again no abrasion on hand or foot, and the patient had handled none of these plants since October, 1896. I concluded, therefore, that the poison must still be in the tissues in spite of the lapse of time (two years) from its first effect.

"*Treatment.*—In each attack I applied a carbolic poultice locally, and administered liquor ferri perchlor. internally. The symptoms began to abate from the commencement of treatment in each case, having up to then gradually got worse.

"*Note.*—The time between the first and second attacks was eight months, between the second and third sixteen months, indicating a gradual elimination of the absorbed poison, also proved by the lesser severity of the symptoms."

Another case is reported in the same volume, p. 1472, and other cases in the *Lancet*, 2, 1896, p. 1802, *et alia.*

POISONING BY RANUNCULUS (SP. VAR.).

Source and Method of Occurrence.—The buttercups form one of the glories of our English flora, and considering the acrid and irritant properties they possess, it is rather remarkable that so few cases of poisoning by them are recorded. Although popularly supposed to be freely eaten by cows and to improve the milk yield when so eaten, it is more probable that cows as a rule avoid them, as may easily be seen in any meadow where *R. acris* grows freely. The white water buttercups are said to be innocuous, and are eaten freely by cattle when opportunity offers (*vide* Sowerby's "English Botany").

The editor can only find reference (*Lancet*, 1, 1897, p. 1781) to one fatal case, and no details are given except that an inquest was held on a boy who died with all the symptoms of irritant poisoning a few hours after eating some buttercups.

POISONING BY RICINUS COMMUNIS (CASTOR OIL PLANT).

Source and Method of Occurrence.—The oil is obtained from the seeds of a plant named *Ricinus communis*.

These seeds contain in the embryo an active poison, *ricinin*, an albumose; and a few of them are sufficient to produce serious symptoms. 'Three or four seeds may act powerfully on an adult. Eight may give rise to serious symptoms, and a large number may destroy life. Their taste is said to resemble that of the almond.

The oil itself is but rarely the cause of dangerous symptoms. All recorded cases are accidental.

Toxicity and Fatal Dose.—The smallest exactly recorded fatal dose of the seeds is two (*Pharm. Jour.*, 1900, p. 305). The oil itself can hardly be said to have any toxic properties, for its ordinary dose is about an ounce for an adult, with a rather disproportionately large allowance for children, as it is a most suitable purgative for them. The cake left after the pressure of the oil is poisonous to rats as well as human beings (Chevallier). When the seeds are swallowed whole they may fail to produce the severe symptoms described below.

Duration.—In the recorded fatal cases death has followed only after some days' interval. In the fatal case from two seeds (above) the patient, a dock labourer, succumbed on the sixth day.

Symptoms.—At the time of eating the seeds there is an absence of any disagreeable taste or sense of heat in the mouth and throat. Soon after the pulp has been swallowed there is severe pain in the abdomen, copious and painful vomiting, with bloody purging, thirst, and convulsions, terminated by death (Bouchardat, "Ann. de Thérap.," 1872, p. 103). A girl, æt. 18, ate about twenty, one of her sisters four or five, and another two castor oil seeds. In the night they were all taken ill. About five hours after the seeds were eaten the deceased felt faint and sick; vomiting and purging came on and continued throughout the night. On the following morning she appeared like one affected with malignant cholera. The skin was cold and dark-coloured, the features contracted, the breath cold, the pulse small and wiry; there was restlessness, thirst, pain in the abdomen, and she lay in a sort of drowsy, half-conscious state. Whatever liquid was taken was immediately rejected, and the matters passed by stool consisted chiefly of a serous fluid with blood. She died in five days without rallying; the two other sisters recovered.

In 1891, several children were admitted into Guy's Hospital after eating castor oil seeds. They all had severe diarrhœa, vomiting, and gastro-intestinal irritation, but recovered.

An officer took as a purgative seventeen seeds. In three hours there was violent purging, followed by vomiting and severe cramps, the patient passing into a condition resembling the collapse of Asiatic cholera. The vomiting was not stopped until after twenty-one hours, and recovery then took place. There was suppression of urine for forty-eight hours (Wiggers and Husemann's *Jahresbericht*, 1872, p. 538).

Two children, aged respectively six and three years, ate some castor oil seeds. The children when brought to the hospital were suffering from extreme collapse, consequent on vomiting and purging, the bodies pale and perspiring, pulse 130. The stools were frequent and watery. The substances ejected from the stomach were pulpy; there was pain in the abdomen, great thirst, and the tongue was furred and dry. There were no cerebral symptoms. Under treatment, they both recovered in two days (*Med. Times and Gaz.*, 1870, 1, 581).

Treatment must be on general principles (*vide* pp. 334 *et seq.*).

Post-mortem Appearances.—In the girl *supra.*—On inspection a large portion of the mucous membrane of the stomach was found abraded and softened in the course of the great curvature.

In the man there was general redness of the stomach, and the abraded portion presented the appearance of a granulating surface of a pale rose-colour; it was covered by a considerable quantity of slimy mucus. The small intestines were inflamed, and the inner surface of them was abraded.

A woman swallowed a quantity of the bruised seeds in place of castor oil, the usual symptoms continued until her death on the fifth day after taking the seeds. The mucous membrane of the stomach and bowels was of a dark colour, much ecchymosed, and presented small patches of extravasated blood ("Ann. d'Hyg.," 1871, 1, 400).

In the fatal case from two beans, the stomach was congested with scattered small erosions. The small intestine was extremely congested, the duodenum and cæcum were less affected (*B. M. J.*, Epit., 1900, 2041).

Analysis.—Castor *seeds* can be identified in the contents of the stomach provided a portion of the outer coat is obtained. These seeds are remarkable for their peculiarly variegated surface. Externally they are of a pale grey, marbled with yellowish brown spots and stripes.

Cases.—The following case, though happily not fatal, corroborates the fact that two seeds are sufficient to give rise to severe symptoms. The case is reported by Dr. Burroughs:—

> "Shortly after two o'clock on August 19th, a porter, aged about fifty, employed on the London and North-Western Railway at Euston station, was brought to my house in a cart, obviously very ill. He then told me that while sweeping out a railway truck he had picked up and eaten two seeds which he said he took to be 'kernels' of some kind. Half an hour after he had eaten them he was overcome with giddiness to such an extent that he was unable to stand, and shortly after vomited eight times in rapid succession.
>
> "Some half-hour later, when he was brought to me, he complained of throbbing in the temples, pains in the head, giddiness, nausea, slight fulness and pains in the stomach, and a sense of dryness and constriction in the throat. His face was very pale, his forehead and cheeks covered with beads of sweat; his lips were blue, his pupils dilated, and his whole face bore a pinched and anxious expression. The rest of his skin was moist and cold. His respiration was slightly quickened, and pulse 84.
>
> "He now told me that he had two 'kernels' similar to those which he had eaten in his possession, which I thereupon examined and took to be rather dried-up specimens of the seeds of the castor-oil plant, both from their external appearance and, on breaking the outer husk, from their peculiarly unpleasant odour, suggestive of the well-known flavour of the oil. No sooner had he handed these to me than he again vomited, and in the matter thus expelled I found several portions of the beans. I then hoped that, as he had already vomited profusely before, this might prove to be the last of the poisonous material; but as his condition did not improve, I evacuated the contents of the stomach, discovering two more small fragments mingled with some blood-stained mucus, after which he seemed greatly relieved. As no further symptoms of poisoning supervened, and his condition steadily improved, I sent him home and saw him on the following day, when he said that he felt comparatively well, but rather weak.
>
> "Dr. Stevenson confirmed the fact that the seeds were those of *Ricinus communis*" (*B. M. J.*, 2, 1903, p. 836).

For another fatal case from two seeds, *vide B. M. J.*, 1, 1900, p. 317.

The following case occurred to the editor late in 1904 (*vide* London Hospital Case Records).

> A. L., æt. 25, the subject of gleet, on his way to work at 3 p.m. on October 24th, 1904, saw some castor-oil beans. Being unaware of their nature and properties, he

picked up and ate about twelve. At first they seemed to taste "rather like walnuts," but as after he had eaten this number a somewhat "sickly taste" developed, he ate no more.

About 5 p.m. (*two hours later*), he was taken ill with:—Violent abdominal pains; obstinate and very painful vomiting and retching every five minutes; vomit "like green treacle," no blood; frequency of micturition (no hæmaturia), every five minutes, five to eight ounces; violent purging for one hour every five minutes; stools "like green treacle," no melæna.

About 7.30 *p.m.* (*four and a half hours later*):—Violent cramps in his legs, which began to draw up, and felt "as if they had lumps in the calves."

About 8 *p.m.* (*five hours later*):—Dizziness, began "to lose himself"; seen by a doctor and sent to hospital.

Condition on admission (*about five and a half to six hours later*):—Face pinched, lips blue, temperature normal, pulse small, low tension, cold extremities, much collapse; on stroking abdomen muscles went into violent tonic contraction; calves contracted violently when cramps came on.

Treatment:—Washed out at once; castor oil ℥ss. statim; calomel grs. iv. statim; ℞ pot. brom. grs. xx.; chloral grs. x.; aq. ad. ℥ss.; ℥ss. per rectum (vomited) 4tis horis; hot bottles to extremities; hot fomentations to abdomen; nutrient enemata.

Course:—Obstinately constipated after entering hospital; pains increased till twelve hours after eating beans; gradually subsided.

Three days later:—Retching still persisted every fifteen to twenty minutes, pains much less severe; pulse still rather rapid and small, though much improved.

Five days later:—Pains and retching stopped; pulse fairly good.

POISONING BY RUBUS (SP. VAR.): BLACKBERRIES.

Source and Method of Occurrence.—The following speaks for itself. Obstruction would seem to be the only danger from the blackberry.

"On September 1st last I performed a post-mortem examination on a child who died from intestinal obstruction under such peculiar circumstances as to make me think it worth while to record the details. Unfortunately I did not see the child before death, and my father, who was acting as my deputy during my temporary absence from home, was only sent for when the patient was *in articulo*. Inquiries, however, have elicited the following history. A healthy and well-nourished boy, aged five years, was absent from home nearly all day on August 28th. He went with other children into the fields and stayed there till towards evening, and during this time his sister stated that he ate many blackberries. On his return home he complained of pain in the abdomen, but went to bed and had a good night. The following day (August 29th) he still had the pain and was kept in bed and given a dose of castor oil, but the symptoms did not seem to have been sufficiently severe to make the parents summon medical aid. The child continued to be in pain all day, and in the evening began to vomit, and there was a slight action of the bowels and also much thirst. The vomiting continued till about 3 a.m. the following morning (August 30th). Whether it was ever stercoraceous I have been unable to ascertain. Medical aid was summoned some hours afterward, but the child became rapidly worse and died at 10.30 a.m. the same day. The necropsy revealed nothing beyond the fact that while the intestines were generally empty, and there was some reddening of the gut at various points, though no exudation of lymph or loss of lustre of the peritoneal covering, the intestine was completely obstructed by the impaction just above the ileo-cæcal valve of a teacupful of green, unripe blackberries, which had apparently been swallowed without mastication. There were also in the mass wheat-grains and other bodies of uncertain nature.

"The short duration of the whole illness, and especially of the vomiting, and the slight changes in the intestinal wall found after death make it seem to me that shock consequent on the severe pain experienced played an important part in causing the fatal issue. Possibly the administration of the dose of castor oil had a good deal to do with the impaction by hurrying the indigestible contents of the intestine downwards towards the ileo-cæcal valve" (Dr. Gornall, *Lancet*, 2, 1896, p. 1078).

POISONING BY RUMEX (SP. VAR.).

Source and Method of Occurrence.—*Rumex acetosa* and *acetosella* are common weeds not infrequently eaten as salad. Fatal poisoning by them is a most rare event. One of the few to be traced is reported by Dr. Suckling in the *Lancet* of July 31st, 1886. Professor Eichhorst, of Zurich, at a recent clinical meeting reported a case of a boy, aged twelve years, who was taken ill on April 26th and who died on May 5th, 1899. The illness commenced with gastro-intestinal symptoms and hæmorrhagic nephritis, and was diagnosed on the first day. The patient eventually succumbed to uræmia. On the day before being taken ill the boy had eaten large quantities of common sorrel (*Rumex acetosa*), and the most careful questioning of the relatives and the attending physician did not bring to light any other etiological factor. Professor Eichhorst mentioned that there are no cases to be found in German literature, but that French veterinary surgeons report fatal cases in horses due to over-consumption of this herb. Under these circumstances it seems particularly important that the public should be made aware of these facts, as common sorrel is considered innocuous and happens to be a favourite dish of boys and girls in early summer (*Lancet*, 2, 1899, p. 60).

POISONING BY SIUM LATIFOLIUM AND S. ANGUSTIFOLIUM OR S. NODIFLORUM: WATER PARSNIP.

Source and Method of Occurrence.—This plant is not unlike watercress, for which it has been eaten by mistake. In 1882, two girls, aged five and three years respectively, died from eating the leaves. The day after these were eaten the younger child became suddenly ill and died, while the other succumbed two days afterwards (*B. M. J.*, 1882, 2, p. 26).

POISONING BY SOLANUM (SP. VAR.).

Source and Method of Occurrence.—There are two species of this plant: the *Solanum dulcamara*, *Bitter-sweet*, or *Woody Nightshade*, which has a purple flower and bears red berries; and the *Solanum nigrum*, or *Garden Nightshade*, with a white flower and black berries. In one instance a decoction of the plant is said to have produced in a man dimness of sight, giddiness, and trembling of the limbs, symptoms which soon disappeared under slight treatment. (For a case of poisoning by the decoction see *Med. Gaz.*, vol. 46, p. 548.)

The berries of the *Solanum nigrum*, in one instance at least, produced serious effects in three children who had eaten them. They complained of headache, giddiness, sickness, colic, and tenesmus. There was copious vomiting of a greenish-coloured matter, with thirst, dilated pupils, stertorous breathing, convulsions, and tetanic stiffness of the limbs. One child died in the acute stage; the others died apparently from secondary consequences during treatment (Orfila, *op. cit.*, 4th ed., 2, 273). From three to four berries of this plant have been found to produce sleep. In 1853, the red berries of the *Woody*

Nightshade are stated to have caused the death of a boy, æt. 4, under the following circumstances. He had eaten some of the berries, and at first did not appear to suffer from them; but eleven hours afterwards he was attacked with vomiting, purging, and convulsions, which continued throughout the day, the child being insensible in the intervals. He died convulsed in about twenty-four hours. The vomited matters were of a dark greenish colour and of a bilious character. Other children had partaken of the berries at the same time, but among these one only suffered slightly (*Lancet*, 1856, 1, p. 715). In 1892, a death was recorded from eating these berries, which, however, were not clearly identified (*Pharm. Jour.*, August 13th, 1892, p. 139).

Toxicity and Fatal Dose.—Death in all these cases is due to the presence of solanine, which is found in the plants. It is a compound alkaloid which has not yet been thoroughly investigated, but is undoubtedly an extremely poisonous body, probably allied to atropine, and may even be an isomer of that body.

Case.—The following seems to be doubtfully a case of poisoning by solanum, for the berries of the *Arum maculatum* are distinctly "noxious."

At Northfield on August 23rd, 1899, an inquest was held on a boy and girl æt. 3 and 6 respectively. The children, who had been playing in an adjoining hayfield under a broiling sun during the day, became ill shortly after being put to bed, and died within an hour or two of each other early on the following morning, seven hours after eating the berries. The opinion expressed by Dr. Bert Jordan at the inquest, that death had resulted through the children eating some poisonous berries, led the jury to desire an analysis of the contents of their stomachs, and the inquiry was accordingly adjourned for that purpose. The analysis was made by the county analyst (Mr. Cecil Cooke Duncan), who reported that amongst the contents of the girl's stomach he found blackberry, gooseberry, currant, and green pea berries, a berry and seed of the *Arum maculatum* (the cuckoopint), and a berry and seed of the common nightshade. The nightshade berries contain two alkaloid poisons, atropine (belladonna) and solanine, and he found evidence of the presence of both. The cuckoopint berries belonged to a class of acrid irritants which had not yet been accurately investigated, but they were extremely poisonous. He found similar berries in the contents of the boy's stomach, and detected the same alkaloid poisons and the acrid irritant berry of the cuckoopint. There was a sufficient quantity of each of the poisons present to cause death, and that of the cuckoopint would produce great suffering.

POTATO POISONING (SOLANUM TUBEROSUM).

The potato is too well known as a domestic vegetable to need any description, but it is not so well known that this edible tuber is the product of a plant in all parts of which a very poisonous alkaloid exists. The plant is a solanum, and the alkaloid solanine is to be found in the flowers, stems, seed, and even in the "peel" of the potato itself.

Cases of poisoning by this means are very rare indeed, but the following suspicious case deserves to be put on record. It is contained in a letter from F. Wallis Stoddart, Public Analyst, Bristol, to Sir Thos. Stevenson, dated August 27th, 1902, and runs as follows:—

"Two children in succession died in one house after a short illness. The first was *in extremis* when seen, and, as the post-mortem revealed nothing, was decided by the medical attendant to have died of 'ptomaine poisoning.' However, when the second case occurred suspicion arose, and an analysis was ordered. The symptoms were very indefinite—some vomiting, history of one or two convulsions, general sort of collapse, and failure of the heart. I was told 'one pupil was slightly dilated,' whatever that means. The viscera were very carefully removed, and the stomach and intestines opened by me in presence of the doctor. There was a little diffuse reddening of the lesser curvature of the stomach, and an injected condition of the lower large bowel, which last, I think, was caused by the tube of a syringe used to wash out the bowel during life. There was no solid matter whatever, but the whole mucous surface was coated with what I found to be a sort of emulsion of castor oil, a dose of which had been given. I received, however, also some undigested matters washed out of the rectum before death, and described to me as gooseberry skins. There were some of these, also pips, etc., but most of the pieces were potato skin and thin flat slices of the starchy tissue such as is removed in peeling. There was evidence also of some germination in one of the 'eyes.' I could find absolutely no poison except a little of our old friend copper in the liver, and gave a very guarded opinion that death was probably due to solanine poisoning, due to eating raw potato peel; but I feel very far from confident about it."

On the occurrence of solanine in the potato as described in Kunkel's "Vergiftung" Mr. Stoddart remarks:—

"The large increase in solanine in 'bad' potatoes is odd. The fact that the alkaloid occurs in quantity in the tissue immediately under the skin is of special interest to my case, as this part, the white portion of the 'peel,' was present in large proportion to other matters. The only point of discrepancy I note is that dilatation of the pupils seems a common symptom in poisoning by potato, though doubtfully characteristic of solanine. In the Bristol case the doctor reported that 'one pupil was slightly dilated,' but that is not very definite to my mind."

On this case the *Lancet*, 2, 1902, p. 693, thus comments:—

"It is undoubtedly the case that there is a time when the potato may contain an important quantity of poison, and this appears to be when the tuber has begun to germinate and to shrivel. In that case the solanine has been found chiefly in the peel and at the root of the eyes or shoots. An interesting account of the symptoms produced by eating diseased potatoes appeared in the *Lancet* as far back as 1846 (February 14th, p. 190). A peculiar affection was invariably traced to the use of diseased potatoes, being ushered in by rigors, hot skin, quick pulse, and abdominal pain. In the next stage rose-coloured patches appeared and as suddenly vanished, and in the majority of cases diarrhœa supervened; in the third stage there was a swollen state of the muscles of the neck, shoulders, and arms, with pain so acute that the patient winced on the slightest pressure. Inability to raise the arms, pains in all the bones, a red erysipelatous state of the face and skin, with œdema of the eyelids so as nearly to close them, were also observed. Ten cases of this affection had occurred in three or four days in the same locality (in Ireland), and all were similarly affected. The case recorded recently need give no grounds for alarm, for an actively poisonous potato is quite a rare specimen. The poison, however, probably occurs normally in the tuber in very small quantity, but this quantity may increase to a poisonous amount in the sprouting, shrivelled, or diseased potato, and then most of it is found in the skin and eyes. In any case diseased potatoes would be naturally avoided, and they are generally discoloured. The risk, of course, would be greater when such a potato is eaten with, as it is often cooked in, its jacket."

"The methods of determining solanine in potatoes have been improved by Professor Schmiedeberg and Dr. Meyer in Strasburg, but no case of poisoning by potatoes has hitherto been described where a quantity of solanine sufficient to produce decided symptoms has been found on chemical analysis. Professor Pfuhl, chief of the hygienic laboratory of the Army Medical Academy of Berlin, has recently published in the *Deutsche Medicinische Wochenschrift* a series of cases occurring in a regiment of the garrison of this city. Between May 29th and June 1st fifty-six men of this regiment were reported ill, the symptoms being those of acute gastroenteritis. The disease began with a rise of temperature to 38° or 39·5° C. (100·4° or 103° F.), headache, colic, diarrhœa, and general debility. In some cases there was vomiting, in others nausea only; several fainted, and one man was seized with convulsions. The majority were drowsy and apathetic; on the following day their conjunctivæ were yellow, and in one case there was general jaundice. A number of them complained of a feeling of tickling in the throat, the mucous membrane of which was slightly swollen. Other complications were herpes labialis and salivation. There was no mydriasis. The fever continued till the third day. There were from four to six motions of the bowels each day, the fæces being diarrhœal in character and containing no potatoes but pieces of undigested plums which had formed part of the men's dinner. In two cases the fever reappeared after two days, but after one or two days the temperature became normal again. The men were kept in bed and were treated with abdominal wet packs, three-decigramme (four and a half grains) doses of calomel, and afterwards with laudanum. Nearly all recovered in a few days. It was found that on May 29th, being Whit-Sunday, a portion of their dinner had consisted of plums and potatoes, the potatoes having been quite recently supplied to the kitchen of the company. The plums proved to be normal, and the potatoes were therefore carefully examined. They were large white, round ones, comparatively few of which had sprouted. They had been boiled for twenty-five minutes. On chemical analysis of the potatoes solanine was found to the extent of 0·38 part per 1,000 in the boiled and 0·24 part per 1,000 in the raw. On an average every man who fell ill had 0·3 gramme (four and a half grains) of solanine, a quantity sufficient to produce toxic effects. The rest of the potatoes were, of course, not used; and accordingly no other cases of poisoning occurred" (*Lancet*, 2, 1899, p. 1554).

POISONING BY STRYCHNOS NUX VOMICA.

Source and Method of Occurrence.—The plant *Strychnos nux Vomica*, from which the seeds are obtained and imported, is not a native of this country. The seeds are well known as flat round kernels about the size of a shilling, covered with radiating silky fibres, and slightly depressed in the centre. They are of a light brown colour, very hard, tough, and difficult to pulverise. The powder is of a grey-brown colour, like that of liquorice or jalap. It is sometimes met with in a coarsely rasped state; it has an intensely bitter taste. It owes its poisonous properties to the presence of the alkaloid *strychnine*, to the extent of about 1 per cent., associated with another alkaloid named *brucine*, of similar but feebler poisonous properties, in a somewhat higher percentage. The average yield of the two alkaloids is about 3 per cent. Strychnine itself has a very bitter taste even in very small quantity; but as it destroys life in a small dose, and it may be given in the form of pills, or professedly administered as quinine or other medicine, it offers every facility for criminal administration. The free sale of vermin-killers containing strychnine affords facilities for poisoning by this alkaloid. Fellowes' "Compound Syrup of Hypophosphites," a proprietary preparation, contains strychnine. Each fluid drachm—the ordinary dose—is stated to contain $\frac{1}{160}$ of a grain of strychnine. Easton's "Syrup" also contains strychnine—$\frac{1}{32}$ of a grain per fluid drachm.

The pharmacopœial preparations of nux vomica and strychnine are:—Of nux vomica itself, liquid extract (one and a half grains in 110 minims), dose one to three minims, a dry extract (5 per cent. strychnine), dose one quarter to one grain, and the tincture (one quarter grain in 110 minims), dose five to fifteen minims; of the alkaloid the only preparation is the liquor strych. hydrochlor. (one grain in 110 minims), dose two to eight minims. These are all ordered to be "standardised."

Strychnine may be accidentally mixed with ordinary medicaments. In 1891 two adults died at intervals of several weeks after the purchase in London of Epsom salts at a particular shop; and in each case it was ascertained that death was due to strychnine.

In 1888, a gardener murdered his wife and son by means of pills containing strychnine, substituted for ordinary purgative pills (*R.* v. *Bowles*, C. C. C., January, 1888). Sir Thos. Stevenson has known extract of nux vomica sold and taken in mistake for extract of sarsaparilla with fatal result.

Strychnine is a scheduled poison under the Act. Although it is thus rendered difficult to procure strychnine at a druggist's shop, it is extensively sold to the public, under the name of vermin killers, in threepenny and sixpenny packets. *Butler's "Vermin Killer"* consists of a mixture of flour, soot, and strychnine. The author found the sixpenny packet to weigh about a drachm, and to contain from two to three grains of strychnine. As the poison is mechanically mixed with the other ingredients, and is manufactured on a large scale, the proportion of strychnine is liable to variation. By the aid of a lens, the poison may be sometimes seen scattered in white particles through the coloured powder. The threepenny packet contains about half the quantity of strychnine, but, as it will be seen, this is quite sufficient to destroy the life of an adult. In place of soot, Prussian blue is sometimes used as a colouring substance. Sir Thos. Stevenson has found two kinds of Butler's "Vermin Killer" in commerce: in one the poisonous ingredient is carbonate of barium (carbonate of baryta), and in the other strychnine. A sixpenny packet of the latter weighed forty-two grains, and yielded two grains and a quarter of strychnine. Another sixpenny packet weighed sixty-two grains, and contained one grain and three-quarters of strychnine. *Battle's "Vermin Killer"* is a powder similar to that of Butler, containing a fatal proportion of strychnine, as it is sold in packets. These powders are a fertile source of poisoning either through accident or design.

In *R.* v. *Vamplew* (Lincoln Autumn Ass., 1862), it was proved that the prisoner, a girl under thirteen years of age, had purchased one of these powders at a village shop and had destroyed her master's infant with it.

There was also reason to believe that this girl had destroyed two infants by similar poisons in two other families where she had acted as nurse. They had all died suddenly in fits. A similar powder purchased for threepence at the same shop consisted of about thirteen grains of flour coloured with Prussian blue and mixed with three-quarters of a grain of strychnine. Another Battle's powder, purchased in London for threepence, weighed, like this, about thirteen grains, and a sixpenny packet weighed twenty-three grains. Sir Thos. Stevenson found a threepenny packet of Battle's "Vermin Killer" to weigh thirteen grains, and to contain one grain and a half of strychnine; and a sixpenny packet weighed twenty-four grains, and contained three grains and a half of strychnine. These vermin killers have caused death in numberless instances. A few years ago the facility with which these poisons were sold to the public by grocers, oilmen, and others, led to their being scheduled under the Pharmacy Act, 1868, so that they can now only be legally procured from registered chemists and druggists, and with registration of the sale in a "Poisons Book" kept for the purpose. It would be easy to add many fatal cases which have fallen within our own knowledge; but they present nothing out of the usual course.

In 1891, thirty deaths were registered in England and Wales from strychnine and vermin killers containing strychnine. In 1901, ten accidental and nineteen suicidal deaths were attributed to strychnine, but it was not recorded as being used homicidally in that year.

Gibson's and *Hunter's* "*Vermin Killers*" (blue) are similar preparations; *Wiggin's* "*Vermin Killer*" (pink) is a weaker powder.

In April, 1904, at Barrow, a child found a box of pills made up to contain the dose of a drachm of Easton's "Syrup." Of these he ate ten, and soon died in convulsions. This is a very typical case of (*a*) the dangers of disguising nauseous drugs by modern pharmacy, and (*b*) the common carelessness with which potent drugs are left about.

Sir Thos. Stevenson has known strychnine to be administered criminally in cocoa, and also in eggs, in tea, and on bread and butter.

Toxicity and Fatal Dose.—The medicinal dose of strychnine for an adult ranges from one-sixtieth to one-fifteenth of a grain. The thirtieth of a grain is an average dose. This quantity has operated as a poison on a child. It caused the death of a child between two and three years of age in four hours. Three-quarters of a grain killed a child, æt. 7½, in half an hour ("Ann. d'Hyg.," 1861, 1, 133). In two cases of adults, in each of which a quarter of a grain had been taken by mistake, the patients recovered only under early treatment. The smallest fatal dose in an adult was in the case of Dr. Warner. *Half a grain* of the sulphate of strychnine here destroyed life ("On Poisoning by Strychnia," pp. 138, 139). So powerful are the effects of this drug in certain cases, that ordinary medicinal doses can scarcely be borne. A gentleman took one-twentieth of a grain of strychnine in six doses during a period of two or three days. Severe fits of tetanus occurred, although half a grain had not been taken altogether. It is probable in such cases that elimination is either arrested or imperfectly performed (*vide* pp. 308 *et seq.*). Tweedie prescribed pills for a gentleman each containing one-fifteenth of a grain of strychnine. He took altogether five of them, or one-third of a grain, at intervals. The patient was seized with alarming tetanic convulsions, continuing for some time. There was also opisthotonos of a severe kind. He slowly recovered. In two cases Sir Thos. Stevenson has found doses of *one-twelfth* and *one-fifteenth* of a grain of strychnine to produce tetanic convulsions. A *fatal dose* of strychnine for an adult may be assigned at from **half a grain to two grains,** although it has been stated that in America deaths have resulted from one-quarter of a grain. This statement Sir Thos. Stevenson has been unable to verify by reference to actual cases.

As in other cases of poisoning, many recoveries have taken place, even after large doses of strychnine have been taken. There are several instances on record in which persons have recovered after taking one grain or more. A case of recovery from two or three grains is reported (*Lancet*, 1861, 2, p. 169). A girl recovered in six or seven hours from a dose of *four grains* of strychnine (*ibid.*, 1863, 1, p. 54). When first seen, she was sensible, and while talking was suddenly seized with the usual symptoms. She had only three paroxysms, and to this probably her recovery was due, as her system was not exhausted by severe and frequent convulsive attacks. There is an instance reported in which a person is said to have recovered from a dose of seven grains of strychnine (*Med. Gaz.*, vol. 41, p. 305), and one in which recovery took place under treatment after the taking of twenty grains of sulphate of strychnine (*B. M. J.*, 1892, 2, p. 179). In reference to this alleged recovery from large doses, it may be a question whether the strychnine was not mixed with some other substance, whereby its poisonous properties were weakened. Instances of recovery from doses of above one or two grains must be regarded as exceptional.

With respect to *nux vomica*, three grains of the alcoholic extract have destroyed life. The smallest fatal dose of the powder was in a case reported by Hofmann, and quoted by Christison, also by Traill ("Outlines," p. 137). *Thirty grains* of the powder, given in two doses of fifteen grains each, proved fatal. The poison was given by mistake for bark to a patient labouring under quartan fever. This is about equivalent to the weight of one full-sized seed, and to only one-third of a grain of strychnine. The dose of nux vomica required to destroy life became of some importance in *R.* v. *Wren* (Winchester Spring Ass., 1851). The prisoner was convicted of an attempt to administer this poison in milk; the quantity separated from the milk amounted to forty-seven grains, which was above a fatal dose. The intense bitterness which the nux vomica gave to the milk led to detection.

Duration.—The *time at which the symptoms commence* appears from the recorded cases to be subject to great variation. In poisoning by nux vomica the symptoms generally appear more slowly than in poisoning by strychnine, *vide* pp. 309 *et seq.* Until they set in the patient is capable of walking, talking, and going through his or her usual occupations. In one case a man swallowed about 300 grains of nux vomica, and no symptoms appeared for two hours. He then died rapidly in a violent convulsive fit ("Ann. d'Hyg.," 1861, 2, 431). On an average in poisoning by strychnine the symptoms appear in from five to twenty minutes. In one case convulsions came on in five minutes ("Ann. d'Hyg.," 1861, 1, 133). In two cases at least, an hour has elapsed (*Lancet*, 1850, 2, p. 259; "On Poisoning by Strychnia" (1856), p. 139).

The longest interval recorded was in the following case:—A boy, æt. 12, swallowed a pill containing three grains of strychnine. No symptoms appeared for *three hours;* they then set in, in the usual way, and death took place in ten minutes. It was proved that the pill taken contained three grains of strychnine, with mucilage. The pills had been prepared eight months previously for the purpose of poisoning dogs; hence they were hard, and would undergo only a slow solution in the stomach (*Lancet*, 1861, 2, p. 480).

The form in which the poison is administered or applied has a considerable influence on the time at which the symptoms commence. Thus when strychnine is given in pills, especially if, as in the above case, they are hard, the symptoms are much longer in appearing than when the poison is taken in solution. Savory gave to a dog two bread pills, each containing one quarter of a grain of strychnine. No symptoms of poisoning had occurred at the end of *two hours*, but the animal was found dead a short time afterwards. When strychnine was given in solution the symptoms soon appeared, and death took place rapidly (*Lancet*, 1863, 1, 515, 548). This fact connected with the absorption of this poison has been ignored (*R.* v. *Palmer*, C. C. C., 1856). Palmer gave to the deceased, Cook, two pills supposed to contain strychnine. No symptoms were observed for an hour and a quarter. More than one expert deposed that this interval rendered it impossible that the symptoms could have been caused by strychnine. The above-mentioned cases will show that this opinion was in conflict with ascertained facts.

If the poison is applied hypodermically or on an ulcerated or diseased surface, or even a healthy mucous surface, absorption may take place rapidly, and the interval for the production of symptoms is then proportionately short.

Schuler relates a case of amaurosis in which about the twelfth part of a grain of strychnine was introduced into the punctum lachrymale at the corner of the eye. Three or four minutes had not elapsed when symptoms of poisoning appeared. There were convulsive respirations, violent tetanic shocks, and the patient appeared about to die. However, the symptoms passed off, and he recovered (*Med. Times and Gaz.*, 1861, 2, p. 67).

Period at which Death takes place.—In fatal cases death generally takes place within two hours after the swallowing of the strychnine. In the case of Warner the symptoms commenced in five minutes, and he was dead in about eighteen minutes. On the other hand, in the case of J. P. Cook the symptoms did not commence until fifty-five minutes after the poison was taken, but the case terminated fatally in twenty minutes after their commencement. In 1870, two deaths are reported to have occurred at Ypres, in Belgium, in which strychnine proved more rapidly fatal than in the case of Warner or Cook.

M. Merghelynk took in pills seven grains and a half of what he supposed to be hydrochlorate of quinine. Violent convulsions came on, and he died in a quarter of an hour. His wife, not suspecting anything wrong, took a similar dose and died in *ten minutes*. A pill containing a grain and a half was given to a dog, which died under the usual symptoms of poisoning by strychnine. The supposed hydrochlorate of quinine was then examined, and it was found to be largely mixed with strychnine.

The case of Madame Merghelynk is, with one exception, the most rapid on record. Gray refers to a case which proved fatal in five minutes ("Strychnine," 1872, p. 55). One of the longest cases for duration was that of an adult, who died in *six hours* from a dose of three grains of strychnine (Guy's Hosp. Rep., 1857, p. 483). Some years ago the editor had an accidental case under his care (it was undoubted strychnine poisoning originally); the girl recovered from the definite symptoms of the strychnine, but died *two days* later, apparently from exhaustion (Lond. Hosp. Case Records, 1894). In 1876, a case was tried (*R.* v. *Silas Barlow*, alias *Silas Smith*, C. C. C., November, 1876) in which the prisoner was convicted for the murder by means of strychnine of a woman with whom he cohabited. The poison was administered in the form of vermin killer, given in decoction of sarsaparilla. The woman lived about five hours and three-quarters after taking the poison. No strychnine was found in the body of the deceased (*Pharm. Jour.*, December 2nd, 1876, p. 467). Clover survived about six hours. In 1893, at Warialda, in Australia, a man took on an empty stomach about seven or eight grains of strychnine; he lived for nine clear hours. Symptoms began within fifteen minutes. Under treatment by washing out the stomach and administering chloral and chloroform, convulsions subsided for over four hours, and then returned and proved fatal at the time stated. The case was recorded by Dr. J. T. Henry, medical officer of the Warialda Hospital, where the victim was treated, and he remarks that the usual assumption that, if a patient lives four hours after poisoning by strychnine, he is practically safe,. was not borne out in the case.

In poisoning by *nux vomica*, death usually occurs within two hours; but Christison mentions a case in which a man died in *fifteen minutes* after taking a dose (*op. cit.* p. 898). This is probably the shortest period known.

Symptoms.—At a variable interval (above) after taking either nux vomica or strychnine in a poisonous dose, the patient experiences a sense of uneasiness and restlessness, accompanied by a feeling of suffocation, and not infrequently by a sense of impending calamity or death. There is a shuddering or a trembling of the whole frame, with twitchings and jerkings of the head and limbs. Tetanic convulsions then commence suddenly with great violence, and nearly all the muscles of the body are simultaneously affected. The limbs are stretched out involuntarily, the hands are clenched, the head after some convulsive jerkings is bent backwards, and the whole of the body becomes as stiff as a board. As the convulsions increase in frequency and severity the body assumes a bow-like form (opisthotonos), being arched in the back and resting on the head and heels. The head is firmly bent backwards, and the soles of the feet are incurved, or arched and everted, the legs sometimes separated. The abdomen is hard and tense, and the chest spasmodically fixed, so that respiration is arrested. The face assumes a dusky, livid, or congested appearance, with a drawn, wild, or anxious aspect; the eyeballs are prominent and staring, and the lips are livid. The intellect is clear, and the sufferings during this violent spasm of the voluntary muscles are severe. The patient in vain seeks for relief in gasping for air, and in requiring to be turned over, moved, or held. The muscles of the lower jaw are generally the last to be affected by this poison. The jaw is not always fixed during a paroxysm. The patient can frequently speak and swallow, and great thirst has been observed among the symptoms. In some cases of poisoning by nux vomica, the jaw has been fixed by muscular spasm, which has come on suddenly in full intensity with tetanic spasms in other muscles. The sudden and universal convulsion affecting the voluntary muscles has sometimes been so violent that the patient has been jerked off the bed. After an interval of half a minute to one or two minutes the convulsions subside; there is an intermission. The patient feels exhausted, and is sometimes bathed in perspiration. It has been noticed in some of these cases that the pupils during the paroxysms are dilated, while in the intermission they are contracted. The pulse during the spasms is so quick that it can scarcely be counted. Slight causes, such as an attempt to move, a sudden noise, a draught of air, or gently touching the patient, will frequently bring on a recurrence of the convulsions. In cases likely to prove fatal they rapidly succeed each other, and increase in severity and duration, until at length the patient dies utterly exhausted. The tetanic symptoms produced by strychnine, when once clearly established, progress rapidly either to death or recovery. The patient is conscious, and the mind is commonly clear to the last. He has a strong apprehension of death. As a general statement of the course of these cases of poisoning, within two hours from the commencement of the symptoms the person either dies or recovers, according to the severity of the paroxysms and the strength of his constitution. Death sometimes takes place in a paroxysm (*Lancet*, 1861, 1, p. 572). The temperature of the body often rises, even ten degrees above the normal (*vide* Vol. I., "Cooling of the Dead Body").

Strychnine poisoning may in some respects resemble tetanus. The following table shows the chief differences :—

Strychnine.	*Tetanus.*
1. Sudden onset in previous good health.	1. Gradual onset with some premonitory symptoms of illness.
2. Does not commence in, nor especially affect, the jaw.	2. Usually commences in, and especially affects, the lower jaw.
3. Relaxation between the fits is quite complete.	3. Relaxation between the spasms never quite complete. Some residual stiffness is invariable.
4. Steadily worse or (and) steadily better.	4. Progress rarely steadily in either direction unless case is very severe or very mild.

Treatment.—If possible, introduce the stomach tube, and wash out the stomach. The administration of chloroform may enable this to be done, otherwise an emetic should be given. Spontaneous vomiting does not usually occur. After emptying the stomach the patient may be kept under the influence of chloroform, or chloral hydrate may be given. A striking instance of the value of chloral hydrate as an antagonist to strychnine is afforded by a case related by Jones (*Lancet*, 1889). A man swallowed two threepenny packets of Battle's "Vermin Killer," which produced typical symptoms of strychnine poisoning; the patient did not vomit, nor was the stomach emptied. Twenty grains of chloral hydrate dissolved in water were injected subcutaneously, followed by a second dose of twenty grains, and subsequently by ten grains more; twenty grains were also given by the mouth as soon as the patient could swallow; recovery took place. If death from asphyxia appears imminent artificial respiration should be resorted to (Mann) (*vide* also case p. 800).

Post-mortem Appearances.—Casper states that in December, 1863, he made a careful examination of the body of a man (who had destroyed himself with strychnine) with a view, if possible, of fixing the special appearances produced by this poison, and of isolating them from those casual conditions of the dead body which have been wrongly described as characteristic of the effects of strychnine.

A healthy man, æt. 30, swallowed from five to six grains of strychnine. For about an hour he lay in his room quietly. At this time spasms commenced, and in his attempt to reach a window he fell and lost all power of moving his legs. He was not seen for another hour, when he was found on the floor, asking for water. In attempting to raise himself, he was seized with tetanic convulsions affecting the whole of his muscles. He had three of these fits in a severe form, and died in the last, three hours and a quarter after the poison was taken. During the spasms, as well as in the intervals, there was complete consciousness.

The body was examined forty-one hours after death. *Externally:* It presented the slight greenish tinge of incipient putrefaction in the loins; there was slight humidity. The expression of the face was that of one quietly sleeping; the eyes were closed, the pupils neither contracted nor dilated. Rigidity was present in its usual degree for the time of observation, well marked, as it always is, in the masseter muscles by which the jaws were firmly closed, and more strongly marked in the limbs which were lying parallel with the trunk. The feet were not incurvated; the fingers, as in other dead bodies, were half flexed inwards, and the nails were blue. There was no evidence of tetanic, still less of opisthotonic, stiffness or rigidity of the body. In short, this body was externally precisely like a thousand other bodies which had come before him; and any physician not informed of the mode of death would have had no suspicion whatever of death by strychnine from the external appearances. (See report of this case, revised by Casper within a few hours of his own death, in Horn's *Vierteljahrsschr. für Gerichtl. Med.*, July, 1864, p. 7.)

Internally: The two outer membranes of the brain were filled with blood, which throughout the body was generally fluid, as in death from asphyxia. It was of a light reddish colour, as in poisoning by carbonic oxide or prussic acid. The brain and spinal marrow were healthy. The muscles of the throat and gullet were of dark violet colour, unlike the other muscles of the body. The lungs were natural, not congested. The right cavities of the heart were collapsed and empty, and the left cavities contained but little blood. The large vessels were also nearly empty. The spleen was congested. The stomach was half full of a mass of partly digested food; the mucous membrane was pale, firm, and softened, and when minutely examined by a lens was found to be perfectly natural. The mucous membrane of the whole of the intestinal canal was in the same healthy state. The kidneys were healthy and not congested. The spinal marrow was specially examined throughout its whole extent, as well as the roots of the spinal nerves. It was cut into in various directions, and in no part did it present any appearance deviating from the healthy condition. So far as appearances went, there was no visible cause of death in this case of an adult healthy man dying in less than four hours from a large dose of this poison, and obviously from its immediate effects. In this respect, strychnine resembles all the other alkaloidal poisons (Horn's *Vierteljahrsschr.*, July, 1864, p. 28).

Casper considered the peculiar colour of the muscles of the throat and gullet as worthy of notice. This was the only deviation from the ordinary appearances which he had been accustomed to meet with in cases of violent death. If he had no previous experience of the condition of the body in death from strychnine, he had unsurpassed opportunities of observing the appearances in all other kinds of violent death. He was thus in a better condition than others to fix upon any that were really characteristic of poisoning by strychnine. Although the examination of a dead body is thus proved to throw but little light upon the question of death from strychnine, still a medical jurist has in the symptoms, their mode of occurrence and progress, sufficient data for a safe opinion.

So far as one case can corroborate Casper's remarks, the following case does so:—

In May, 1892, Sir Thos. Stevenson exhumed the body of Matilda Clover, who had died six months before from strychnine administered six hours before her death. The body, except as regards the face, neck, and fingers, was in an unusual state of preservation. Nearly all parts of the body, including the fluids, had an acid reaction. There was no rigidity, but the muscles were firm. Sanguineous fluid in the pleural cavity showed the spectroscopic appearances of recent blood (*R.* v. *Neill*, C. C. C., October, 1892).

In other instances of strychnine poisoning no particular degree of rigidity has been found at any period after death. In rabbits poisoned by similar doses of strychnine, the author observed the body of one to remain perfectly rigid for a week, while another had lost all rigidity, and had begun to putrefy, after thirty-six hours. For the circumstances which affect the commencement and duration of this condition of the dead body see Vol. I. It is not any special influence of the poison on the muscles, but the mode in which it operates on the system, that determines the commencement and duration of rigidity in the dead body.

In the case of Cook, the rigidity of the limbs, including the hands and feet, is reported to have been well marked when the body was disinterred about two months after burial. The great rise of temperature in strychnine poisoning may cause the body to be warm for an unusual length of time after death (Vol. I.).

In most instances the stomach and intestines have been found quite healthy, for this poison neither inflames nor irritates the mucous membrane. Of the appearances observed in poisoning by strychnine there are none which can be considered characteristic. Congestion of the membranes of the brain and spinal marrow is probably the most common.

With regard to the state of the heart and lungs, their condition, as to fulness or emptiness, depends rather on the mode of dying than on the actual cause producing death.

Although then it is now universally admitted that there is nothing either externally or internally that is pathognomonic of strychnine poisoning, the reader is referred to "Changes in Muscles" (Vol. I.), for some points explanatory of certain features in rigor mortis, etc., which may be corroborative of actual death *from* strychnine, as opposed to death *after* taking it as a medicine.

Analysis.—**Persons have died from strychnine, and no trace of the poison has been found in the body.** In a case of poisoning by this alkaloid, which was the subject of a trial for murder in 1861, Reese made separate analyses of the contents of the stomach and the contents of the intestines, as well as of the tissues, and each one of these was repeated to avoid error. Yet there was no evidence of the presence of strychnine by the bitter taste of the final extract, nor by the colour tests. In Reese's case the quantity taken was unknown, the woman lived five or six hours, and the body was not examined until six weeks after death. A small but fatal dose, and the duration of the case, will sufficiently account for the negative results without resorting to any other hypothesis. In the case of Mrs. Salter, who died from a dose of strychnine in 1869, death probably took place within two or three hours; but the most careful examination made of the stomach and liver by Horsley led to a negative result. Strychnine, in the opinion of all the medical witnesses, was the cause of death, but no trace of strychnine could be detected in the body by one well qualified to detect it. There was some reason to think that the poison had been taken in solution, but even under these circumstances it must have been rapidly absorbed, diffused, and eliminated. Bernays found no strychnine in the body in the case of Silas Barlow beyond a trace in the stomach. The woman had survived the administration of the poison nearly six hours.

When death has been caused by small doses applied under the skin the poison may not be found in the tissues. The following experiment was performed in May, 1864. One-eighth of a grain of acetate of strychnine in coarse powder was placed in the subcutaneous tissue of the neck of a rabbit. In nine minutes the animal was seized with a sudden convulsion, and fell on its side; its fore and hind legs were rigidly stretched out, and its body passed into a state of opisthotonos. It had a succession of fits, and died in one of them twenty minutes after the commencement of the symptoms. One-half of the powdered acetate was still found in the wound, showing that the rabbit had been killed by the $\frac{1}{16}$th of a grain. Of course the residuary strychnine was easily detected in the wound; it was plainly visible to the eye. On applying Stas's process to the heart, as well as the blood and the liver, the tests failed to indicate the slightest trace of the alkaloid. The ethereal liquid left no crystalline residue of any kind. This result does not show that strychnine is not absorbed, but it proves that under certain conditions it has not been detected in the organs of the body in cases in which, beyond all doubt, it has destroyed life. In some instances in which death has been caused by nux vomica, which contains only 1½ per cent. of strychnine, the alkaloid has not been found deposited in the tissues.

The following case shows the rapidity with which the poison may be diffused and deposited in the tissues when a large dose has been taken:—

> A strong healthy man, æt. 43, placed upon his dry tongue, at 10 p.m., a powder which contained six grains of Dover's powder and five grains of strychnine (dispensed by mistake for five grains of James's powder). He complained of a bitter taste, asked for an orange, and found, on sucking this, that it increased the bitterness; the acid juices of the orange dissolved the strychnine, and thus favoured its early absorption. In fifteen minutes, he went to bed. Twitchings of the muscles then came on, and the patient, from previous experience in taking strychnine as a medicine, was fully aware of the cause of the symptoms. He complained of his bowels being drawn up; he drew his knees up as if to his mouth, gave a yell, seized a friend who was standing by, and became apparently unconscious (exhausted) for about five minutes. He then revived, but in a few minutes was again seized with a violent convulsion of a tetanic character, and he died in two or three minutes afterwards, a little over half an hour after taking the powder. Owing to a spasmodic closure of the jaws, he was able to speak only for a few minutes at a time; he was rational, but seemed to be in great terror.

Edwards found strychnine in the stomach, the quantity being estimated at about one grain. He also found the poison in the tongue and the liver. He sent to the author a portion of the liver, one kidney, and six ounces of blood. They were in a putrescent state, and when examined about three months after death, eight ounces of the liver yielded by the process above described prismatic crystals of strychnine, producing the usual colour reactions with sulphuric acid and peroxide of manganese, as well as with bichromate of potassium. The quantity of strychnine thus obtained was small. The kidney and the blood did not give results on which any reliance could be placed. This case shows that a large dose of strychnine, rendered soluble, will destroy life in half an hour; that within this short time four-fifths may be removed from the stomach, or at least not be discoverable there by careful chemical analysis after death; that in half an hour the poison may be distributed through the body and deposited in the soft organs, although no satisfactory evidence of its presence could be obtained from less than half a pound of animal matter. The strychnine found in the tongue was probably a portion of the powder swallowed, which still remained there. It may be further remarked that, although the deceased took in the powder six-tenths of a grain of opium, no morphine was present in the crystalline residue obtained from the liver.

In those inspections in which there has been such criminal interference or culpable neglect as in that of J. P. Cook, the only course for an analyst is to seek for the poison in the tissue. This case settled nothing in reference to the presence or absence of strychnine in the body of a person poisoned by this substance. Except the actual destruction of the stomach itself, everything had been done which could be done in order to render a chemical analysis fruitless. It cannot therefore be taken as a fair precedent in any sense for the results of a proper medico-legal research in poisoning by strychnine. In an analysis of this case by Casper (Horn's *Vierteljahrsschr.*, July, 1864, p. 26), not only are the chemical results regarded as negative by reason of the gross mismanagement of those who inspected the body, but the post-mortem appearances themselves, for a similar reason, are considered as throwing no light upon the effects of strychnine on the body. One of the medical witnesses for Palmer could see in the whole case nothing but angina pectoris, another only epilepsy, with "tetanic complications," and a third admitted death from poison, but not from strychnine. Assuming that there had not been a criminal interference with the dead body on the part of the prisoner Palmer, the position assumed, that strychnine, if a cause of death, must always, and under all circumstances, be found in the dead body, is incorrect. Its detection in the body, properly verified, is a proof that it has been taken; the symptoms in their commencement, progress, and termination will furnish irrefragable proof that it has acted as a poison; but its non-detection does not prove that it has not destroyed life, or, in the words of Casper, "Das Nichtauffinden des Giftes allein kann, aber niemals einen Gegenbeweis abgeben."

For a more complete history of the *medical* facts in the memorable case of Cook *vide* "Poisoning by Strychnia," Guy's Hosp. Rep., 1856; *Pharm Jour.*, July, 1856, p. 6 (from the pen of the late Jacob Bell). The most able legal analysis of it by any English writer which the author saw was published by Stephen in his "General View of the

Criminal Law of England" (1863, p. 357). Of the foreign reports one by Tardieu in the "Ann. d'Hyg." for 1856, 2, 371, and 1857, 1, 132, and the other by Casper in Horn's *Vierteljahrsschr. für Ger. Med.*, etc., 1864, 2, p. 1, are the most correct in their medical and medico-legal details.

In the form of powder nux vomica yields to water and alcohol, strychnine, brucine, igasuric or strychnic acid, and some common vegetable principles. Heated on platinum foil, it burns with a yellow smoky flame. Nitric acid turns it of a dark orange-red colour, which is destroyed by stannous chloride. These properties are sufficient to distinguish it from various medicinal powders which it resembles. In one case of poisoning by this substance (*R.* v. *Wren*) a quantity of guaiacum powder was mixed with the nux vomica. This so completely changed the action of nitric acid, as in the first instance to create some difficulty in identifying the substance. The analyst must be prepared for these admixtures or adulterations.

The aqueous *infusion* or *decoction* is reddened by nitric acid, and is freely precipitated by tincture of galls. Ferric sulphate gives with it an olive-green tint. The fine silky fibres or hairs which cover the surface of the seed may be obtained by washing the residue of the powder in the stomach, or the sediment of any liquid with which the nux vomica may have been mixed. They present a characteristic appearance under the microscope. As in other poisonous seeds or roots, the strychnine is slowly removed from the powder by the absorbent vessels of the stomach, and carried into the blood, until that liquid is sufficiently impregnated with the poison to produce symptoms. The powder itself remains, as it is unalterable by the fluids of the stomach. Strychnine may be extracted from nux vomica by the process described on p. 352.

There is one caution to be given in reference to the examination of the stomach. As death is commonly rapid, and there is no vomiting, the colouring matter, either soot or Prussian blue, should always be sought for in the stomach. Strychnine may or may not be found, according to the amount swallowed and the degree to which absorption has gone on during life.

Strychnine.—This alkaloid may be readily obtained crystallised from an alkaline solution. The crystals are very small, and their form is subject to great variation, according to the strength of the solution, the rapidity or slowness of evaporation, the presence of foreign matters, etc. They are commonly seen in octahedra, sometimes lengthened into prisms, bevelled at the ends, and crossing each other at angles of 60°. There are as many as six or eight varieties of crystals, so that too much importance must not be attached to their form. When strychnine is procured from the solutions of its salts by the addition of ammonia, it is usually deposited in long slender prisms.

(1) Strychnine itself is white, of an intensely bitter taste, even when it forms only $\frac{1}{300000}$th part of a solution. (2) When strongly heated on platinum, it melts, and burns like a resin with a black smoky flame; in a close tube it yields ammonia. (3) It is not perceptibly dissolved by cold water, requiring 7,000 parts for its solution. (4) It is easily dissolved by acids, and is precipitated from its concentrated

solutions by potash or ammonia, in both of which it is insoluble. (5) Strong nitric acid imparts to commercial strychnine a pale reddish colour, owing to the presence of brucine. (6) Sulphuric acid produces no apparent change in it; but when to the mixture a small crystal of either bichromate of potassium, ferricyanide of potassium, or a small quantity of black oxide of manganese or of peroxide of lead is added, a series of beautiful blue, violet, and purple colours appear, which pass rapidly to a light red tint. Among these substances, black oxide of manganese will be found preferable. By reason of its insolubility, it imparts no colour to the liquid if strychnine is absent; and if the alkaloid is present it slowly brings out the colours, so that there is time to make full observation. The hydrated or precipitated oxide may be used in place of the anhydrous compound. Permanganate of potassium has been recommended as a substitute for the oxide, but it is objectionable on account of its solubility, and of its being itself coloured. Letheby suggested the use of a small galvanic battery for the production of the coloured reaction. In this case sulphuric acid only is required. It presents no practical advantage over the use of oxide of manganese. (7) Sulphomolybdic and iodic acids produce no change of colour in strychnine, and thus distinguish it from morphine.

The *salts* of strychnine are readily soluble in water, and these solutions are precipitated by the usual group reagents for alkaloids. The alkalies and alkaline carbonates, if diluted, precipitate the alkaloid in slender prisms. Sulphocyanide of potassium and chromate of potassium give well-defined prismatic crystallisations. In the last case the crystals are stellated and of a yellow colour. Chromate of strychnine may be also produced by adding bichromate of potassium to a dialysed liquid containing strychnine. On draining the crystals, drying them, and adding sulphuric acid, the colour reactions are at once brought out. Picric (carbazotic) acid is even a more delicate precipitant of a solution of strychnine. It gives small tufts or groups of stellated crystals. Sulphocyanide of strychnine in crystals may be produced in solutions containing not less than one seven-thousandth part of strychnine. Filhol recommends as delicate precipitants of solutions of strychnine chlorine and auric chloride, taking care that there is no alcohol in the liquid to be tested. Auric chloride slowly precipitates, in a crystalline form, even the six hundred and fiftieth part of a grain of strychnine. When these precipitates, drained of water, are treated with concentrated sulphuric acid, they are dissolved, and to this mixture a crystal of bichromate of potassium may be added to bring out the blue coloration peculiar to strychnine.

Strychnine has been fatally mistaken for santonin (*Lancet*, 1870, 1, p. 598), salicin, and jalapin, and has thus caused death on several occasions. Jalapin does not crystallise, and the crystalline forms of santonin and salicin are very different from those of strychnine.

These two vegetable principles differ from strychnine in their properties. When heated in close tubes, they give off *acid* vapours. Salicin is soluble in water. Santonin is not soluble in water, but is dissolved by alcohol. Tannic acid and potassio-mercuric iodide do not precipitate the solutions, while they readily precipitate those of strychnine. Nitric acid has no effect upon either, while sulphuric acid, which does not change santonin, gives a pink colour to salicin. The crystals of santonin closely resemble, in microscopical appearance, those of salicin, but they are distinguished from salicin and from alkaloids by acquiring a brilliant yellow colour on exposure to sunlight without undergoing any change of form.

From *organic mixtures* the alkaloid is separated by the process on p. 352.

The crystals, after an examination by the microscope, are treated with sulphuric acid and black oxide of manganese, and the colour reactions of strychnine, if the alkaloid is present, will then appear. By this method strychnine may be detected in the organs of a person who has died from this poison, although the organs are in a highly putrescent state. The process of dialysis will allow of the separation of strychnine when combined with acids and in a state of solution from blood, mucus, and other viscid organic matters found in the stomach. On three or four occasions it has been detected in exhumed bodies, in the case of Clover six months after burial. The liquid containing the salt of strychnine may be tested by evaporating a few drops and applying the colour test. If thus found to be present, it may be neutralised by ammonia or potash and shaken with ether or chloroform in order to obtain pure strychnine. The dialytic process of separation has been successfully carried out by Gray. The reader will find in Gray's essay on strychnine a full account of the method of employing this process for the detection of the poison in organic liquids and the best modes of applying the tests ("Strychnia," by St. Clair Gray, Glasgow, 1872, p. 75). In all cases the physiological test should be used to supplement the chemical tests for strychnine. A frog may be employed for this purpose.

The reader will find an account of the processes for strychnine in organic solids and liquids in some papers published by Wormley in his "Micro-chemistry of Poisons," 2nd ed. (New York, 1885, p. 586). He describes a case in which, from a misapplication of the process, strychnine was sworn to be present, when, from the chemical method pursued, the alkaloid could not possibly have been separated; and two instances fell within the author's own knowledge where the colours produced by sulphuric acid and bichromate of potassium, on the concentrated and dry organic contents of the stomach, were referred to strychnine, when they were really due to the decomposition of the substances employed in contact with organic matter. In one case Sir Thos. Stevenson found strychnine where a previous analyst had confounded the alkaloid with veratrine. The detection of this poison in the stomach or the tissues will depend on the same conditions as those observed in other cases of poisoning. If a person takes a large dose and dies quickly, a residuary portion may be readily found. In *R.* v. *Burke* (Clonmel Sum. Ass., 1862), the prisoner administered strychnine to his wife in Epsom salts. She died in about half an hour under the usual symptoms. More than three grains of the poison were extracted from the contents of the stomach. If a small dose has been taken, and the person has survived some hours, it is possible that none will remain in the stomach. It has been suggested that the presence of morphine counteracts the colour tests; but unless in admixture with the strychnine in large proportion, this is not probable. Besides, in Stas's process the morphine is scarcely dissolved by ether.

Sir Thos. Stevenson believes that much smaller quantities of strychnine may be detected when mixed with organic matters than the author (Taylor) admitted; and that with improved methods of analysis strychnine can hardly fail to be detected in the body in any case of poisoning by this alkaloid proving fatal within a couple of hours. As a rule it may be readily detected in the urine during the course of a case of strychnine poisoning, and also when the alkaloid is being given only in ordinary medicinal doses. That strychnine is absorbed into the blood unchanged is incontestably proved by the experiments of Vulpian, who killed a dog by transfusing into its veins the blood of another strychnised animal. Strychnine resists decomposition to a greater extent than the other common alkaloids, and hence, when given in large doses, is often detected in the exhumed bodies of animals. Sir Thos. Stevenson extracted one-sixteenth grain from two pounds of the exhumed viscera of a woman (Matilda Clover) more than six months after burial, although the deceased had survived the administration of the poison for six hours. There is, so far as he is aware, no other recorded case of the detection of strychnine in this country after exhumation, though two cases are recorded on the Continent of its detection after exhumation of human remains (*R.* v. *Neill*, C. C. C., October, 1892).

Strychnine in Organic Solids.—From the vermin killers of Butler and Battle the strychnine may generally be readily separated by means of alcohol, and procured in a crystalline form for the application of tests. If the vermin killer is coloured with Prussian blue, one or two drops of sulphuric acid will remove the colour from the separated alkaloid, and black oxide of manganese may be added. The colour reactions are then as well marked as with pure strychnine.

The alkaloids strychnine and brucine may be detected in the **powder of nux vomica** by the following process:—Digest the powder in a small quantity of diluted sulphuric acid by a water-bath heat. The substance should be well stirred with the diluted acid, which, after a short time, completely carbonises it. The mass is heated to dryness, then treated with a small quantity of distilled water and filtered, by which an acid liquid of a pale sherry colour is obtained. On neutralising this liquid with potash or ammonia, and agitating it with twice its volume of ether, the strychnine is separated, and may be obtained crystallised by the evaporation of the ethereal solution. The strychnine may also be obtained by dialysis. Ten grains of nux vomica, equal to three-tenths of a grain of strychnine, gave satisfactory results. Prismatic crystals were procured which gave the appropriate reactions with the colour tests. Brucine was also detected by the action of nitric acid on the crystals. Brucine is much more soluble in alcohol than strychnine. If, therefore, the mixed alkaloids are dissolved, in hot alcohol, they may be conveniently separated by fractional crystallisation.

In cases in which the poison is contained in pills or powders having much organic matter soluble in alcohol it will be advisable to

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employ either dilute or concentrated sulphuric acid. It is a remarkable fact that strychnine itself is not acted on in the same degree by sulphuric acid as ordinary organic matters, or even other poisonous alkaloids.

Analysis of Brucine.—An alkaloid generally associated with strychnine. It is contained in the seeds of nux vomica, and more abundantly in the bark of the tree. It is not so powerful a poison as strychnine, but the symptoms which it produces are similar. It is considered to have from one-twelfth to one-fortieth the strength of strychnine. It is not affected by the colour tests employed for the detection of strychnine, and it acquires an intense red colour on the addition of nitric acid, and this is changed to a violet on the addition of stannous chloride. It is more soluble in water than strychnine and has a similar bitter taste. Hydrochloric and iodic acids produce in it no change, either in the cold or when heated. Sulphuric acid usually gives to it a pink-red colour without carbonising it, owing to the presence of a trace of nitric acid in the acid; sulphomolybdic acid does the same, but the red colour changes to greenish brown, and ultimately to blue-black. The sulphate of brucine crystallises in well-defined prisms truncated at the ends. They are larger and longer than the prisms of strychnine.

Cases.—The following personal narrative of an accidental case of strychnine poisoning is so interesting as to deserve nearly verbatim report. It is taken from the *South African Med. Jour.*, April, 1895, pp. 341 *et seq.*, and is from the pen of Dr. W. T. Harris, himself the victim:—

> "In January, 1893, it happened that I had for a few weeks been in the habit of taking an occasional dose of one of our stock dispensary mixtures—a tonic containing, amongst other things, a fair dose of strychnine. The weather was very sultry, the work very onerous, as it always is in the first few weeks of the year, when Government statistics have to be prepared, and I was hourly expecting a cablegram from home to announce a bereavement which can only occur once in a lifetime, and which in fact did come four days later. It was therefore not because of any real illness, but only from being anxious and below par, that on the morning of Tuesday, January 10th, on coming over from my residence to the hospital at about 10.30, previously to commencing out-patients, I went into the dispensary before the dispenser had arrived, to take a dose of the tonic I have alluded to. It is kept in a concentrated form, the whole bottle containing five drachms of the liq. strychniæ P.B., and each ounce of the diluted mixture five minims. Somewhat carelessly, I poured out sufficient to make an ounce and a half, and filling up the measure-glass with water, drank it off.
>
> "I at once noticed a much more intensely bitter taste than was usual; for although this characteristic of the drug may be detected in very dilute solutions, it seemed increased tenfold, as indeed it was almost, as I shall presently show. I immediately asked the porter if he knew when the mixture had been made up, and he replied that it had been done on the previous day, but as yet none had been dispensed from the bottle.
>
> "I did not quite know what to do, and my first impulse was to take an emetic; but, as the swallowing of saliva lessened the bitter taste every minute that I hesitated, I persuaded myself that the difference might be only fancy.
>
> "I had made a good breakfast, and was loath to sacrifice my mutton-chop and upset my stomach, only to be laughed at; for how could a large stock bottle be made up so improperly that an ordinary dose would do me harm? And was it not ready to be dispensed for a number of other people? I shook off my fancies therefore, and going into the consulting-room, rang the bell for out-patients, and went on with the morning's work.
>
> "Fifteen minutes elapsed, and I began to feel very restless. An indescribable

nervous sensation came over me, as if there were rope pulleys running down to my extremities, which were gradually being drawn tight. I had to make an effort to prevent my mouth closing too soon as I spoke, and to dig my pen into the paper and write thick, as if to form a fulcrum over which to lever my hand along the pages, while a contra-force in my arm strove to dash the pen to the floor.

"Fortunately there were but few patients to see that morning, and I had just finished them, when, at a little before eleven o'clock, Dr. Considine, who was visiting surgeon for the day, came in. I at once told him that I felt very strange, and feared I had taken an overdose of this strychnine mixture. He laughed and said I was nervous, knowing that we both had taken the same medicine often with impunity. He then commenced talking on some topic in which we were usually interested, when I broke in abruptly, saying, 'I feel I cannot sit still and talk; let us go round the wards.'

"We started through the principal male ward, which is a daily routine, and one always of interest, and generally of pleasure. But the simple round on that particular day seemed then in fact, what it still appears to memory, a dreadful nightmare. My limbs were throwing off the control of will, and moved erratically; when I wished to go on, my legs stopped, and when by a violent effort I forced them to proceed, I could not pull up to a stand-still without walking against a bed to steady myself. What I said or did I cannot remember, but I managed to get along somehow, though feeling as if head, hands, and legs belonged not to me, but to three separate individuals, like a mechanical doll that has had all its limbs jerked with each pull of the string. At length we returned to the top of the ward, when, feeling a paroxysm down my back, I said to Dr. Considine, 'I am really very ill. I feel sure I am suffering from strychnine poisoning.'

* * * * *

"I had taken six-tenths of a grain."

Then follows a most graphic description of his thoughts and feelings as a condemned man. He said, "Shall I have an emetic?" and Dr. Considine said, "No, it is too late; take sixty grains of chloral." "Now go," said the doctor, "to the ophthalmic room, and smoke hard, if you can manage to."

"I turned to go. 'You'll come soon; do not leave me for long,' I said. 'I'll come immediately, and not leave you, however long it is, till you are better.' The words imbued me with new courage, though, as he told me afterwards, he feared the worst, and only stayed to get chloroform, morphia, and a hypodermic syringe, should they be wanted.

"I got down the passage, laid on the couch, and tried to smoke, but there was no rest possible; it was like lying on the felt floor of a Turkish bath. As one flinches there from the heat of contact with surrounding objects, so here every touch sent a tetanic convulsion through me. I could not rest; should I get worse and have opisthotonos? Would the chloral stop, or only stay the action of the poison? Was it to be a reprieve, or only a respite? I started to my feet and got over to the book-case, to see what Taylor's 'Jurisprudence' said as to the oncoming of symptoms and the period of danger.

"The book was not there, and I remembered that I had taken it over to my residence. How was I to get across the garden to my study, sixty or seventy yards away? What should I do if I met any one, how afford an explanation with every muscle on the work, and feeling unable to articulate? I could only hope to get in and out unobserved, for I felt that not only would any attempt to explain bring on a paroxysm, but that I should cause the greatest alarm by my appearance. I started, and how I steered myself across is a problem still. I ran in jerks and jumps, like a drunken man makes a dash from one lamp-post to another.

"I regained the room in the hospital, and, steadying myself between couch and table, turned to the accounts of strychnine poisoning, feeling a 'trembling of the whole frame' and 'impending suffocation' as I hurriedly glanced at those very words, so well describing my own symptoms. The accounts were conflicting:—'A man swallowed three hundred grains of nux vomica, and no symptoms appeared for two hours; he died speedily in a convulsive fit'; again, 'In the case of Dr. Warner, half a grain of strychnine destroyed life; the symptoms commenced in five minutes, and he died in twenty minutes'; further on, 'The longest period at which death has occurred was six hours after the administration of the poison,' and I thought that, like me, he might have taken it on a full meal. There was no comfort so far, but at last my eye fixed on this: 'In fatal cases death generally takes place within two hours.' To that I pinned my faith, for it was nearly twelve o'clock, and every movement was a step towards safety.

"I was able now to lie down, for the chloral was certainly taking effect, not as a hypnotic, for I was never more wide awake, but I could feel it 'coursing through the narrow straits and alleys of the body,' with a gentle glow, and the spasms were abating.

"Dr. Considine, who had been coming in and out, now settled down beside me, his cheery words being an important factor in tiding me over the next hour. He did everything to divert attention from myself, relating how he had once taken an overdose of strychnine, and had used tobacco as the only antidote available. The question of more chloral was considered, but no more was given, as I had had a large dose, which he rightly thought would prove sufficient; and more was at hand at any moment had acute symptoms returned.

"As is usual in these cases when once the poison is eliminated, I felt but little subsequent effect beyond some weariness after the shock.

"I have now come to the end of my narrative, in which I have endeavoured to portray faithfully the sensations, mental and bodily, that I went through. That I did not get worse, and actually recovered after only the one large dose of chloral, I attribute to my generally good constitution, to the fact that I had habituated my system somewhat to the action of strychnine by having taken for a week previously medicinal doses of it two or three times a day, and to the prompt administration of the antidote at the critical moment, when the symptoms were coming to a climax."

The following case, reported in the *B. M. J.*, 1, 1894, p. 300, is of interest as showing the stability of strychnine in solution. It is reported by Dr. Percy T. Adams :—

"Recently I attended a strong, healthy man of twenty-one years of age who, save for an occasional severe attack of toothache, had enjoyed good health. I found him breathing stertorously, cyanotic, and unconscious, and upon taking his wrist he was seized with a general muscular clonic paroxysm, commencing in the muscles of the forearm, and then becoming general throughout the body. These tetanic muscular contractions passed into tonic contractions, and were most marked in the muscles of the hands, forearms, thorax, and face. Tonic spasm continued. Dyspnœa became rapidly worse, owing to the fixity of the respiratory walls and muscles.

"With a few clonic contractions of the facial muscles of a hideous, grinning character, and screwing together of the mouth by the orbicularis oris, the man died. Opisthotonos slight when first seen only.

"*Points of Medico-legal and Pathological Interest.*—(1) Quantity of drug taken, thirteen and a half to eighteen grains, in the readily assimilable form of liq. strychninæ, B.P.; (2) relatively slow speed (namely, fifteen to twenty minutes) at which so large a dose killed when taken upon an empty stomach, for the man drank it directly out of the bottle before breakfast. This solution had been kept often exposed to light for probably six years, but was apparently unaltered as regards its potency."

The following is reported by Dr. S. H. D. Hale, of Southsea, in the *B. M. J.*, 2, 1899, p. 10 :—

"I was called in July, 1898, at 2 p.m., to see a woman who was reported to have fallen and injured her head. She was lying semi-conscious on the floor, with a large but not dangerous scalp wound.

"On examination it was at once seen that the injury to her head was not the cause of her symptoms. It transpired that she had swallowed six drachms of the tincture of nux vomica in mistake for another drug. She quickly developed symptoms of strychnine poisoning: severe muscular twitchings developing into general tetanic spasms, and on three occasions definite general convulsions with loss of consciousness. During the intervals she was quite lucid and conscious, complaining of great thirst, dryness of the mouth and throat, a suffocating sensation, and fear of impending death. Her pupils were widely dilated, her lower extremities powerless, her skin dry, respirations quick and deep at first, changing later into the Cheyne-Stokes rhythm; and the pulse was hard and incompressible.

The slightest touch readily started a general spasm, and she was very intolerant of light and sound. Exactly two hours after swallowing the fatal dose she died, during the third attack of general convulsions, and was not resuscitated after half an hour's artificial respiration.

"It was found quite impossible to pass the tube of the stomach-pump, as any attempt to do so at once brought on tetanic spasms; and on administering chloroform she developed such dangerous symptoms of syncope that this had to be abandoned. Accordingly one-eighth of a grain of apomorphine was injected subcutaneously, but this had no effect whatever in producing vomiting, the dose being repeated in half an hour with a similar negative result. Two doses of chloral hydrate one drachm each were given by the mouth at intervals of half an hour, and during the three attacks of general convulsions a drachm of ether was injected subcutaneously, and hot flannels were applied to the precordial region.

"The chief points of interest about this case seem to be—(1) that the fatal dose was three-quarters of a grain of strychnine; (2) the comparatively rapid action of the dose; (3) that the pupils were widely dilated, and there was loss of consciousness on three occasions; (4) the failure of apomorphine to produce vomiting; and (5) the dangerous symptoms induced by the exhibition of chloroform."

The following, reported by Dr. Potts in the *Lancet*, 2, 1900, p. 486, is instructive owing to the manner in which the drug was taken, to the fact that the species of strychnos was an unusual one, and also especially to the fact of recovery after what was probably a large dose :—

"I found the patient on the floor in a state of tetanic convulsions and struggling violently. From the nature of the convulsions I came to the conclusion that she was suffering from strychnine poisoning, and I at once attempted to produce vomiting by administering mustard-and-water. Failing in this, I returned home for a stomach-pump.

"On my return to the house the patient was having an exceedingly severe convulsive attack; respiration had ceased; she had become quite cyanosed. The pulse could not be felt at the wrist, the eyeballs protruded from their sockets, and the tongue was thrust half out.

"It appeared to me that the patient was dying. Luckily the convulsion relaxed, and the tube was passed down to the stomach; and with a funnel attached to the other end, her stomach was repeatedly washed out both with warm mustard-and-water and plain warm water. After this had been done an immediate improvement was noted; the convulsions grew gradually slighter and slighter, until by shortly after 11 a.m. she remained quiet unless touched. We agreed to see her in an hour's time (12 noon). Then the patient stated that she was much better, but complained of feelings of great giddiness, with pains in the loins and numbness of the legs. When about to observe the condition of the pupils, which were somewhat dilated, merely touching the eyebrow produced a considerable amount of twitching of the whole body. Bromide of potassium was now given in small doses. By 4 p.m. the patient had so far recovered as to get up and walk up to her bedroom, on another floor.

"Twitching continued to a certain degree for twenty-four hours afterwards, otherwise her recovery was uninterrupted. The patient, a woman sixty-seven years of age, was the widow of a herbalist, and she had been in the habit of taking some of her husband's preparations when she thought fit. The substance that she took was a combination of various extracts : the extracts of *Strychnos Ignatii*, valerian, and one or two others of no importance. Her statement was that, feeling giddy in the morning, she took some of these extracts, thinking they would act as a 'pick-me-up.' She said that she took a little of the first on the end of a knife, mixed it with hot water, and drank it off. She then sat down to her breakfast, taking tea, a little bacon, and bread. She felt sick, endeavoured to vomit without effect, and slipped off her chair on to the floor, and the convulsive attacks commenced."

For a case of severe vesical spasm following four minim doses of the B.P. liq. strych. *vide B. M. J.*, 1, 1895, p. 135.

In 1898, a trial for strychnine poisoning took place which is thus recorded and commented on by the *Lancet*, 1, 1898, p. 1628 :

"On June 6th, the trial of Walter Horsford for the murder of his cousin, Annie Holmes, a widow, was concluded. After five days' investigation at the Huntingdon Assizes, before Mr. Justice Hawkins, the prisoner was convicted and sentenced to death. The facts of the case were briefly as follows: Horsford, who had recently married, had received an intimation from Mrs. Holmes that she believed herself *enceinte*, with the implication that he was the author of her trouble. In his reply, he repudiated liability on the ground that she had received monetary consideration, and expressed a wish that no more letters should be sent to him, as he did not wish his wife to know of the relations which had existed between them. In December last, Horsford purchased at a chemist's a large quantity of arsenic, and ninety grains of strychnine, alleging that he wanted them to exterminate vermin. One day, early in January, Mrs. Holmes, who had been in her usual health, retired to bed, taking with her a glass of water, an unusual circumstance. Shortly afterwards her daughter, aged about thirteen years, found her mother in great agony. The neighbours were called in, and Dr. Joseph Herbert Anderson, acting as assistant to a local practitioner, was fetched. He found deceased suffering from symptoms of strychnine poisoning and administered antidotal sedatives. Treatment proved of no avail, and in a short time the unfortunate woman expired.

"At the inquest, Horsford, in his evidence, denied that he had had immoral relations with his cousin, or that he had visited her, or that he had sent anything to her. These statements were demonstrably contrary to fact, for he had been twice to see her, and there was the letter above referred to. He was arrested on a charge of perjury and was subsequently indicted for wilful murder. After Mrs. Holmes's death some letters were found beneath the mattress of the bed, together with two papers, one of which, though nearly empty, contained a little strychnine, whilst the other held thirty-five grains of the alkaloid. On one of the packets was written 'One dose take as told,' and also the significant expression 'It is quite harmless.' The analysis of the viscera and their contents revealed the presence of a large quantity of strychnine. From the characteristic symptoms and the chemical analysis, there could be no shadow of doubt that the deceased had died from strychnine poisoning. The questions to be determined were: Was the alkaloid taken by accident, or was it administered with a felonious intent? and if the latter, who was the guilty person? Although strict inquiries were made, none other than Horsford likely to be known to Mrs. Holmes, and to be interested in her affairs, was found to have purchased strychnine from the chemists for some distance around. Fortunately there was no difficulty in comparing Horsford's known handwriting with the direction on the packet containing the powder. The likeness between the two was so striking that it scarcely needed an expert to appreciate it. Now, whether Horsford caused to be administered the poison with the intent to procure abortion, a proposition purely visionary, or to compass death mattered not. The post-mortem examination showed that Mrs. Holmes had not been pregnant within a short period of her death. But even this mistake as to her condition would not have diminished the criminal responsibility, since the Act in considering the penalties for the procuring of abortion distinctly says 'whether the woman be pregnant or not.' The chief contentions for the defence were (1) that some other person than Horsford might have been the guilty party; (2) that the strychnine found in the papers might have been put under the bed subsequently to the death of Mrs. Holmes; and (3) that it was not likely that Horsford, 'who only valued Mrs. Holmes's body at half a crown,' a sum he acknowledged to have given her, would sacrifice her body and soul at the risk of losing his own life. As regards the first, it may be remarked that there was not the slightest testimony that any other person than Horsford had any reason for taking her life. The other points are too puerile to merit discussion.

"Since the time of Palmer no case of murder by strychnine poisoning so foul in every sense of the word has been brought to light as that now under consideration. United to his victim by ties of blood, in debt to her morally for the wrong he had done to her, Horsford hesitated not to treacherously take the life of a lonely widow, and make her innocent children orphans, and all for the miserable gain of freedom from the consequences of his lust. The links in the chain, or rather the strands in the rope, of evidence were so convincing, so natural in their connection and cohesion, that none but the wilfully blind could for a moment hesitate to endorse the verdict."

Poisoning by Taxus Baccata, or Yew.

Source and Method of Occurrence.—The yew tree (*Taxus baccata*) is indigenous in England, and in the days of bows and arrows was largely planted, so that it is now a very common tree. Poisoning by it is almost entirely a matter of accident, and is much commoner in cattle than in human beings. The red pulp of the fruit has a sweetish pleasant mucilaginous taste, and is innocuous, but the green seed inside the pulp is distinctly poisonous. It is now well ascertained that yew leaves and the hard central portion of the berries exert a specific poisonous action both on men and cattle. If animals recover from the primary effects, they are liable to die after several days from inflammation of the bowels. On one occasion the author examined the viscera of an ox which had died from the poisonous effects of yew-leaves. There was much inflammation, and in some parts of the intestines gangrene had taken place. Infusion of yew-leaves, which is popularly called yew-tree tea, is sometimes used for the purpose of procuring abortion by ignorant midwives. A case of death from a person drinking this infusion is reported in the registration returns for 1838-9. In the returns for 1840 there is also one death of a female, æt. 34, referred to her having eaten the berries of the yew.

Toxicity and Fatal Dose.—The toxicity of the plant is due to taxin, an alkaloid obtained from the berries and leaves. It is not official, but its dose (Martindale, "Extra Pharm.") is given as one-hundredth to one-sixtieth of a grain. It is therefore a dangerous poison.

There is no record of the exact minimal lethal dose, but a teaspoonful of the leaves has proved fatal.

A lunatic woman had been employed in preparing evergreen decorations. Nothing unusual was observed by the nurses in attendance until about 10.30 p.m. She had had some bread-and-cheese with the other patients, when in about five minutes she slipped off her chair almost helpless. Her countenance turned of a dusky pallid hue, but there were no cerebral symptoms. She vomited a quantity of food mixed with a few bits of yew-leaves. She soon passed into a state of collapse, and died in less than three hours from her first seizure. She retained her consciousness until a few minutes before she died, and admitted that she had eaten some little bits of yew, but she did not think anything of it. The broken leaflets in the vomited matters and the portions found in the stomach and bowels after death did not amount to a teaspoonful. Yew-leaves may thus prove in small quantity a rapidly fatal poison.

For further points *vide B. M. J.*, 2, 1899, p. 1377.

Duration.—Symptoms appear in an hour or less; and death or recovery ensues within eight or ten hours, but may be delayed for longer periods. In the non-fatal case *infra* the symptoms did not come on till the fourth day of taking a decoction of the plant.

Symptoms.—The symptoms produced by the *leaves* and *berries* are fairly uniform in character; convulsions, insensibility, coma, dilated pupils, paleness of the countenance, small pulse, and cold extremities, are the most prominent. Vomiting and purging are also observed among the symptoms. The subject of one case, a girl about five years of age, died in a comatose state in four hours after she had eaten the *berries*, and in another case a boy, æt. 4 years, died nineteen days after taking the berries, obviously from severe inflammation of the bowels. The immediate symptoms in the boy were vomiting, purging, coma, convulsions, dilated pupils, hurried respiration, a small pulse, and a cold skin (see *Prov. Jour.*, November 29th, 1848, p. 662, and December 27th, p. 708). A tablespoonful of the fresh *leaves* was administered to three children of five, four, and three years of age as a vermifuge. Yawning and listlessness soon succeeded; the eldest vomited a little, and complained of pain in the abdomen, but the two younger children suffered no pain. They all died within a few hours of each other.

A lunatic died from the poisonous effects of *yew-leaves*. The deceased was observed chewing the plant, and before the attendants had taken it from him he had succeeded in swallowing a portion of the masticated juice. He was soon afterwards suddenly seized with giddiness, prostration of strength, vomiting, coldness of the skin, spasms and irregular action of the heart. He died in fourteen hours. On inspection the stomach was found much distended; and it contained some yew-leaves (*Dub. Hosp. Gaz.*, 1, 1845, p. 109).

Treatment.—Empty the stomach, and counteract collapse by all general measures. There is no specific antidote known.

Post-mortem Appearances.—Judging from the effect of the plant on cattle, it would seem to have considerable power as an irritant to the intestine; but there is nothing characteristic about the appearances, *i.e.*, pointing to yew, and not to any other irritant.

A girl, æt. 19, took a strong decoction of the *leaves* to bring on the menses The dose taken was a tumblerful for four successive mornings. Severe vomiting followed, and this was promoted by tepid water. Delirium came on, and the patient died eight hours after taking the last dose. It is stated that nothing of importance was revealed by an inspection of the body (*Lancet*, 1870, 2, p. 471). In another case a girl, æt. 13, took the leaves for a similar purpose. Death took place rapidly, without any other symptoms of poisoning than vomiting. On inspection there was congestion of the membranes of the brain, liver, and kidneys, a greenish colour of the contents of the stomach and intestines owing to the fragments of yew-leaves, and stellated inflammation of the mucous membrane of the stomach and bowels.

A child, aged three years and a half, ate a quantity of *yew berries*. In an hour afterwards the child appeared ill, but did not complain of any pain. It vomited part of its dinner, mixed with some of the berries. A medical man was sent for, but the child died in convulsions before he arrived. On inspection the stomach was found filled with mucus, and the half-digested pulp of the berries and seeds. There were patches of redness in the mucous membrane, and this was so much softened that it could be detached with the slightest friction. The small intestines were also inflamed.

A lunatic ate a quantity of the *berries*, and seven hours afterwards he was found dead sitting in a chair. On inspection of the body the right cavities of the heart were distended with fluid blood of a dirty plum colour. The mucous membrane of the stomach was reddened and softened with patches of black congestion. The duodenum was in a similar state. In the lower part of the small intestines there was a mass of the berries. The liver and other soft organs were much congested (*Med. Times and Gaz.*, 1870, 2, p. 446; see also 1871, 1, p. 386, for another fatal case).

Analysis.—Fragments of the leaves or the berries may be found in the stomach. The yew and the savin are the only coniferous poisonous trees which are likely to require separation. The apex of the leaf of the yew is not so pointed as that of the savin, and the yew-leaf does not possess the peculiar odour of savin when rubbed. Yew berries are seen in autumn; they are about the size of a pea, of a light red colour, dull on the surface, and translucent. They are open at the top, allowing a hard brown kernel to be seen. This is of an ovoid shape, and it forms the greater part of the berry. The fine red skin contains a colourless and remarkable viscid or adhesive juice, which reddens litmus paper, and has a sweetish taste.

Taxin may be sought for by the ordinary process for obtaining alkaloids.

Cases.—In 1902 a trial took place (*R.* v. *Pym*, Lancaster Ass., March, 1902) before Mr. Justice Bucknill in which the prisoner was charged with administering yew to a woman with intent to procure abortion. The prisoner was acquitted on the ground that she did not know that the girl was pregnant. The case is thus recorded by Dr. Barling:—

> A pan was filled with leaves and twigs of yew, filled with water, and boiled for several hours. A teacupful was taken three times a day. For three days nothing was noticed. On the fourth day the girl complained of "pins and needles" in the epigastrium, followed by nausea and constant pain. On the seventh day she vomited. The pain got worse, and she had diarrhœa. At the end of a fortnight she could hardly stand, and one night became unconscious. The stuff was discontinued, and she rapidly recovered.

Poisoning by Vanilla.

Source and Method of Occurrence.—The familiar flavouring agent is probably a synthetic product, though it should be the product of the vanilla plant. The following is from the *B. M. J.*, 2, 1899, p. 934:—

"Nineteen persons, one of whom subsequently died, suffered severely, Wassermann tells us (*Zeitsch. f. Diätet. und Physik. Therapie*, 1899, Bd. 3, Hft. 3), from the effects of eating some vanilla 'cream.' This was composed of milk, eggs, sugar, and flavoured with vanillin (the commercial article prepared from coniferin). The dish had been cooked in the evening and allowed to stand, uncovered, in the dining-room till noon next day. Investigation showed that the eggs and sugar were good, that the milk alone was harmless, and that the vanillin was pure. The fact that the cook and landlady, who had merely tasted the dish, had also become seriously ill, suggested the idea that the poisonous agent might have undergone further development after being swallowed—that is, that it was bacterial. Wassermann boiled three flasks containing respectively plain milk, milk flavoured with vanillin, and a solution of vanillin in water, then let them stand eighteen hours at a temperature of 37° C. (98·6° F.). Some of the contents of each flask were injected into mice. The milk flavoured with vanillin was poisonous, the other two harmless. Filtration through a Berkenfeld filter rendered this poisonous milk inert, while a mixture of milk and vanillin kept for eighteen hours on ice, instead of at a temperature of 98·6° F., was harmless also; 0·02 to 0·1 per cent. crystalline vanillin added to culture media was found (1) to inhibit the growth of aerobes (Klebs-Loeffler, pneumococcus, etc.), (2) to assist that of anaerobes (tetanus, anthrax, etc.), (3) and to have no effect either way on facultative aerobes (typhoid, coli communis). It was therefore concluded that the milk had been contaminated with anaerobic bacteria, whose development had been assisted by the vanillin. The exact variety of bacterium was not discovered. The symptoms were choleraic: low temperature, great prostration, lassitude and headache, severe vomiting and diarrhœa, cramps in the calves and thighs, frequent micturition, thirst, etc. Recovery took place gradually. Wassermann quotes several other cases of vanilla poisoning in which the vanilla pod, and not vanillin, had been employed. As regards prophylaxis, the only thing to be done is to see that the milk and other ingredients of the dish are pure. As these anaerobic bacteria resist boiling, precautions against contamination must begin at the dairy."

POISONING BY VERATRUM ALBUM AND VIRIDE.

Source and Method of Occurrence.—Neither of these plants is British. Their toxic principles have been investigated by Wright and Luff, who found veratrine and cevadine. Taylor stated that he never met with a criminal case of poisoning by veratrine. The common veratrine of the shops is sometimes given medicinally in doses of one-sixth of a grain. It forms a grey non-crystalline powder, scarcely soluble in water even on boiling; but is more readily dissolved by alcohol and ether. It has a slight alkaline reaction, and combines with acids, forming soluble salts.

Toxicity and Fatal Dose.—Luff ("For. Med.") states that veratrine first stimulates and then paralyses both motor and sensory nerves. A physician prescribed medicinally for a lady one grain of veratrine divided into fifty pills, and three were directed to be taken for a dose. Not long after the first dose had been swallowed the patient was found insensible, the surface cold, the pulse failing, and there was every symptom of approaching dissolution. She remained some hours in a perilous condition, but ultimately recovered. Supposing the medicine to have been well mixed, and the pills equally divided, not more than one-sixteenth of a grain of veratrine was here taken. This case proves that the alkaloid is capable of exerting a powerful effect. Death has taken place after taking about eighteen grains of powdered veratrum root, but recovery has occurred after much larger quantities of the root have been taken (Luff).

Symptoms.—In one case, salivation and profuse sweating occurred; vomiting was frequent; great oppression was felt in the epigastric region, together with soreness of the throat and profound prostration; there was no diarrhœa. Recovery took place under prompt treatment. In another case reported by Blake nearly three grains of veratrine were accidentally swallowed by an adult. The patient complained of giddiness, sickness, constriction of the throat, thirst, diarrhœa with tenesmus, and a tired, weak, faint feeling. The tongue was swollen, and the mouth and throat were sore; the pupils were extremely contracted, the respirations hurried, and the pulse was quick and small; micturition was frequent. A continued tingling was felt over the entire body, with now and then intolerable fits of itching in different parts; There was no sneezing. Recovery took place under treatment, the irritation of the skin being the last symptom to subside (Mann).

Treatment must be on general principles, the same as for aconite (Luff).

Post-mortem Appearances.—Nothing characteristic.

Analysis.—Veratrine has a hot, acrid taste, without any bitterness. Strong nitric acid gives to it a light red, turning to an ochreous, colour. Diluted sulphuric acid, when heated with the powder, or a residue containing veratrine, produces an intense crimson-red colour. Boiled with strong hydrochloric acid, it yields a fine purple colour. It undergoes no change of colour with iodic acid or sulphomolybdic acid.

Mann adds the following tests:—"Applied to the mucous membrane of the nostrils, veratrine causes violent sneezing. A drop or two of strong sulphuric acid added to a little veratrine in a watch-glass and well mixed develops a yellow colour, which quickly changes to orange and finally to cherry-red. If the mixture is warmed it becomes red immediately. Salicin treated with sulphuric acid turns red immediately without heating. Narcotine gives a similar reaction, but takes hours to acquire the red colour. Hydrochloric acid with veratrine produces no change until the mixture is heated, when it becomes red. Sulphomolybdic acid added to a fragment of veratrine produces a brick-red, which becomes dirty brown, greenish, and finally blue. If a little veratrine is mixed with five or six times the amount of cane-sugar, and moistened with concentrated sulphuric acid, a yellow colour is first produced, which changes to green and finally to blue. With ammonium selenate and sulphuric acid veratrine yields a brownish yellow, which changes to rose-red."

Case.—A gentleman swallowed experimentally one drachm of tincture of green hellebore (*Veratrum viride*), equal to twelve grains of the powder. He was found soon afterwards in a collapsed state, the features sunk, the skin cold and covered with a profuse clammy sweat, the pulse scarcely perceptible. He complained of intense pain in the region of the stomach. There was no purging. These symptoms were relieved by treatment, and the next morning the patient had recovered (*Med. Times and Gaz.*, 1863, 1, 5).

GROUP 8.—POISONS OF ANIMAL ORIGIN.

As a group poisoning by foodstuffs should here come in, but that subject is best kept to itself as another group. This exclusion leaves us then only cantharides and snake venom to deal with.

POISONING BY CANTHARIDES.

Source and Method of Occurrence.—The substance is the dried body of a beetle (*Cantharis vesicatoria*), used in medicine externally as an irritant and internally (very seldom used) for its effect upon the kidneys (stimulant). Cantharides have been not infrequently adminstered, either in the state of powder or tincture, for the criminal purpose of procuring abortion, but they are not often a cause of death in this country. Out of 1,620 fatal cases of poisoning in four years there were only two which were ascribed to cantharides.

Cantharides have been in some cases wantonly used, and with great danger to life, with a view of exciting sexual feelings. The doses in which it has been given have been such as to cause symptoms of irritant poisoning.

In November, 1859, six female servants in a gentleman's family, as well as the master and mistress, were attacked with the symptoms of poisoning by cantharides.

It appeared that the coachman of the family had shortly before the occurrence purchased an ounce of this poison; that he had put the cantharides into beer and coffee, and had thus poisoned the whole household. He was tried, but acquitted of any indictable offence, on the ground that his intent was not to murder. It was this case which led to an alteration in the law.

At the Liverpool Lent Assize, 1861 (*R.* v. *Wilkins*), a man was indicted for administering powdered cantharides to a woman.

The prisoner had mixed it in a cup of tea; the prosecutrix took a portion of the tea, and suffered from vomiting and other symptoms produced by this substance; she skimmed a quantity of the powder from the tea, on which it floated, and its nature was then determined. The prisoner was convicted of the act of administration, but a question arose in reference to the intent.

The jury found that he had administered the powder with the intent to excite the sexual passion of the woman, for which the new statute had not provided, as this makes the offence to depend only on the intent to injure, aggrieve, or annoy.

The only official preparation for internal use is the Tincture dose 2 to 5 minims, or 5 to 15 minims for one dose.

Toxicity and Fatal Dose.—The *quantity* of this poison required to produce serious symptoms, or to destroy life, has been a frequent subject of medico-legal inquiry. Doses above a drachm of the tincture are likely to be injurious, and to give rise to symptoms of poisoning. On a trial which took place at Aberdeen, in 1825, it appeared that a drachm of the powder had been administered; severe symptoms followed, but the person recovered. A witness said he had given ten grains of the powder as a medicinal dose. In three cases, a drachm of the powder, mixed with six ounces of rum, was taken by each person, robust healthy negroes. They suffered severely, but recovered in about ten days. In these cases, irritation of the urinary organs did not appear until after the men had been bled.

The smallest quantity of the powder which has been known to destroy life was in the case of a young woman, quoted by Orfila. The quantity taken was estimated at *twenty-four grains* in two doses. She died in four days; but as abortion preceded death, this may have been concerned in accelerating that event. Her intellect was clear until the last. In one instance a man recovered after having taken *two drachms* (*Med. Gaz.*, vol. 42, p. 873). An *ounce* of the tincture has been known to destroy life. This dose was taken by a boy, æt. 17, and he died in fourteen days. This is, perhaps, the smallest dose of the tincture which has proved fatal. Four drachms and even six drachms have been taken; and although the usual symptoms followed, the parties recovered. The last case was the subject of a trial at the Central Criminal Court in September, 1836. Six drachms of the tincture were administered to a girl æt. 17. The questions here arose whether half an ounce was sufficient to kill a person, as also what proportion of cantharides was contained in an ounce of the tincture. One ounce of the tincture is equivalent to six grains of the powder; but as the proportion of *cantharidin*, the substance on which the poisonous properties depend, is subject to variation, it is not unlikely that the tincture varies in strength. A case is quoted by Pereira ("Mat. Med.," 4th ed., vol. 2, part 2, p. 750) in which it is said six ounces of the tincture were taken by a man without causing dangerous symptoms. This must have been an unusually weak preparation, and probably the insects from which the tincture was made contained little or no cantharidin. The same writer mentions a case within his own knowledge in which one ounce of the tincture caused serious symptoms. The powder cannot be so readily administered as the tincture, since a large portion of it floats for a time on any liquid with which it is mixed, and attracts attention by its peculiar appearance.

Symptoms.—When taken in *powder*, in the dose of one or two drachms, it gives rise to the following symptoms: a burning sensation in the throat, great difficulty of swallowing, violent pain in the abdomen, nausea, and vomiting of bloody mucus; there is also great thirst and dryness of the throat, and in a few cases observed by Maxwell salivation was a prominent symptom. As the case proceeds a dull heavy pain is commonly experienced in the loins, and there is an incessant desire to void urine, but only a small quantity of blood or bloody urine is passed at each effort. The abdominal pain becomes of a violent griping kind. Purging may supervene; but this is a symptom which is not always observed: the matters discharged from the bowels are mixed with blood and mucus, and there is often tenesmus (straining). In these, as well as in the vomited liquids shining green or copper-coloured particles may be commonly seen on examination, whereby the nature of the poison, if it has been taken in powder, will be at once indicated. After a time there is severe priapism, and both in the male and female the genital organs are swollen and inflamed. In one instance, observed by Pereira, abortion was induced, probably owing to excitement of the uterus from the severe affection of the bladder, for there is no proof that this substance acts directly on the uterus to induce abortion. With respect to the aphrodisiac propensities said to be caused by cantharides, these can seldom be excited in either sex, except when the substance is administered in a dose which would seriously endanger life. When the case proves fatal, death is usually preceded by faintness, giddiness, and convulsions. The *tincture* of cantharides produces similar symptoms. They are, however, more speedily induced, and the burning sensation and constriction of the throat and stomach are more strongly marked. This symptom is often so severe as to render it impossible for the person to swallow, and the act of swallowing gives rise to excruciating pain in the throat and abdomen.

Treatment.—Empty the stomach and treat on general principles. Fatty substances must be avoided (Mann).

Post-mortem Appearances.—In one well-marked instance of poisoning by this substance, the whole of the alimentary canal, from the mouth downwards, was inflamed. The mouth and tongue seemed to be deprived of their mucous membrane. The ureters, kidneys, and internal organs of generation were also inflamed. In another instance in which an ounce of the tincture was swallowed, and death did not occur for fourteen days, the mucous membrane of the stomach was not inflamed; but it was pulpy and easily detached. The kidneys, were, however, inflamed. The brain has been found congested, and ulceration of the bladder is said to have been met with. There are few fatal cases reported in which the appearances have been accurately noted. Indeed, the greater number of those who have taken this poison have recovered. In a case which occurred to Saunders, death took place in about twenty-four hours. The deceased must have taken the greater part of half an ounce of cantharides in powder. The symptoms were such as have been above described. On inspection the vessels of the brain were filled with dark-coloured blood, and the ventricles were distended with serum. Both lungs were highly engorged with dark-coloured blood. The gullet was partially inflamed, and there were patches of inflammation on the mucous coat of the stomach, which had become detached in several places. The same inflammatory appearance existed in the small intestines, in the folds of which the powder of cantharides was abundantly present. The vessels were distended, and the liver was engorged with dark blood. The gall-bladder was much distended with bile, and none of this secretion appeared to have passed into the bowels. The spleen and kidneys were highly congested; the ureters were inflamed; the bladder was contracted and empty, and its internal surface pale. The glittering of the particles of cantharides on the viscera during the inspection by candlelight was very remarkable (*Med. Times*, February 3rd, 1849, p. 287). Cantharides powder has no local chemical action: the poison is a pure irritant, and the effects observed on the stomach are entirely due to irritation and inflammation.

Analysis.—The wing-cases and other parts of the beetle must be carefully looked for (*vide* p. 346).

Cantharidin is a neutral crystallisable principle.

For the detection of *cantharidin*, which forms on an average only $\frac{1}{250}$th part of the flies, acidify and digest the suspected solid or the liquid contents of the stomach (evaporated to an extract) in successive quantities of ether, concentrate these ethereal solutions by slow evaporation, and then observe whether the concentrated liquid applied to the skin of the lips, or the lobe of the ear, produces blistering. The $\frac{1}{100}$th of a grain of cantharidin dissolved in ether is said to possess blistering properties. For the detection of the powder, the suspected liquids, mixed with alcohol, should be spread on sheets of glass, and allowed to evaporate spontaneously to dryness. The shining scales will then be seen, on examining by reflected light either one or both surfaces of the glass ("Ann. d'Hyg.," October, 1842). As the powder is insoluble in water, some portion of it may be obtained by washing and decantation. The sediment may be examined on a glass slide with the microscope.

Chloroform may be used for the separation of cantharidin from the tincture or from an alcoholic or aqueous extract of the contents of the stomach. An ounce of chloroform may be frequently shaken with the acidified suspected matters and left in contact with them twenty-four hours. The chloroform is then separated by a funnel, filtered, and allowed to evaporate spontaneously in a watch-glass. A pellet of lint of the size of half a pea, pulled out, is moistened with a drop of olive-oil, and the residue in the watch-glass taken up by it. This is placed upon the arm, lobe of the ear, or lip, and covered with goldbeaters' skin. When taken off in three or four hours, the skin is very red, and on wiping it with chloroform a vesicle may have been produced (*Chem. News*, February 14th, 1863, p. 78). The quantity of cantharidin detected in this way has amounted to only the $\frac{1}{80}$th part of a grain.

This mode of operating is preferable to the use of ether, as cantharidin is less soluble in ether than in chloroform. Half an ounce of the tincture of cantharides will yield to chloroform a crystallisable principle, having the characters assigned to cantharidin. In practice it will be found advisable to concentrate the liquid as much as possible before adding the chloroform.

The evidence of the presence of cantharides, or of their having been taken, is necessary to support a criminal charge; for however unambiguous the peculiar effects on the generative and urinary apparatus may appear to render the symptoms produced by this poison, the medical jurist should be aware that similar symptoms may proceed from disease. An important case of this kind has been reported (*Med. Gaz.*, vol. 12, p. 431).

A young lady was suddenly seized with vomiting, thirst, pain in the loins, strangury, and considerable discharge of blood from the urethra; the generative organs were swollen and painful. She died in four days. She was governess in a family, and there was some suspicion that she had been poisoned with cantharides. The stomach and the kidneys were found inflamed, and the bladder also. This contained about two ounces of blood. No poison was detected; and indeed it was pretty certain, from the general evidence, that none could have been taken.

Cases.—At a meeting of the Royal Academy of Medicine in Ireland in May, 1904, Dr. F. C. Martley brought forward a case in which an elderly woman had been poisoned by cantharides. About an ounce of the powdered drug had been administered to her in a glass of rum, but in spite of the amount having been so large, she survived for thirty-one and a half hours.

SNAKE POISON.

Source and Method of Occurrence.—Luckily there is apparently in England only one species of snake the bite of which is to be feared, and even that is rare except in certain parts, and but seldom, if ever, voluntarily attacks a human being, so that the experience of English medical men in snake-bites is practically nil. Far otherwise is the experience in our Indian possessions, where poisonous snakes abound, and take a very large toll of human lives annually.

Toxicity and Fatal Dose.—Dr. Fraser, of Edinburgh, and Dr. Calmette, of Paris, stand out as the chief investigators of the toxicity of snake venom, and to their published writings the reader is referred. *Vide* also *Lancet*, 1, 1904, p. 349, for an article by Dr. Leonard Rogers on the action and treatment of the poison. A valuable table is there given. Here we can only refer to the well-known fact that snake venom is comparatively inert when swallowed.

Duration.—The action of the poison is remarkably rapid, death taking place frequently within a quarter of an hour and usually within a few hours.

Symptoms.—Collapse and cardiac failure are the main symptoms. For details the articles referred to above must be consulted.

Treatment.—Unless some of Dr. Calmette's (or other) anti-venine be at hand, treatment can only be symptomatic. The following is interesting (*Lancet*, 2, 1901, p. 622):—

" Dr. Calmette, the director of the Pasteur Institute at Lille, has, as every one knows, discovered a curative serum for the effects of snake-bite. This serum he prepares with his own hands in his own laboratory by immunising animals with successive doses of snake venom. He was only the other day severely bitten by a trigonocephalus. This, however, was not due to any carelessness upon his part, for he takes every precaution in collecting the venom, and has invented a kind of forceps which he introduces into the cage, and with which he seizes the head of the snake so that it cannot escape. The cage is then opened, and the snake being forced to open it mouth, the venom, which appears in drops at the point of the fangs, is collected in a Pravaz syringe. Despite all precaution the forceps must have slipped, for Dr. Calmette was severely bitten on the right hand, and the venom of the trigonocephalus is extraordinarily rapid in its action. Dr. Calmette without delay gave himself an injection of his anti-venomous serum, but nevertheless the hand swelled up, and acute fever set in; but by the afternoon of the same day Dr. Calmette was sufficiently recovered to attend a sitting of the Conseil-Général of the Department, at which he argued in favour of a grant in aid of the sanatorium which he had undertaken to found at Lille. On the following day he was perfectly well, having thus afforded in his own person, albeit unwillingly, a convincing proof of the efficacy of his excellent remedy."

Strychnine injected hypodermically is also of use (*Lancet*, 1, 1895, p. 645. *Vide* also *Lancet*, 2, 1899, p. 609).

GROUP 9.—POISONING BY FOODSTUFFS.

Source and Method of Occurrence.—In all cases of poisoning by foodstuffs the symptoms are caused by one or other or both of two things: a living microscopic organism and a chemical poison of greater or less virulence. There are, however, several distinct methods in which foods may poison, and it is exceedingly important to bear them in mind.

1. The so-called food may not be fit for human consumption originally; *e.g.*, certain molluscs, fungi, fish, etc., etc., eaten in ignorance.
2. The food itself may be perfectly wholesome in every way, but it may disagree with its host from (*a*) unsuitability to circumstances as to age, exercise, illness, etc.; (*b*) idiosyncrasy.
3. The food may contain definite poison owing to the animal having fed on plants poisonous to human beings (*e.g.*, belladonna), or it may contain definite metallic poisons.
4. It may have in it the germs of specific infectious diseases; *e.g.*, typhoid in oysters, scarlet fever or diphtheria in milk.
5. It may have in it pathogenic (to man) bacteria of the pyogenic or other non-specific class.
6. It may have in it simple chemical products of decomposition, which act as irritants to the alimentary canal of the host (toxalbumoses or ptomaines).
7. It may have parasitic worms in it in some stage of development.

Method.—1. **Food (so-called) originally unfit.**—Particulars under this head need hardly be given. *Vide* "Poisoning by Fungi," and other vegetables unfit for human consumption. Certain kinds of fish and other animals eaten by starving wrecked sailors, etc., are other rarer illustrations, but they occur from time to time on our coasts and elsewhere; some of the cases below under 2 (*b*) are doubtless of the same nature.

2. (*a*) **Unsuitability.**—It is unnecessary to more than mention this. When "the baby gets what we have ourselves," there is no need

to go farther for an explanation why it does not thrive. A particularly flagrant example was the subject of an inquest on March 30th, 1904, before Mr. Troutbeck, in which a child died as the result of being fed on tinned milk and a food prepared by a local chemist.

Indigestion and acute gastritis in adults are further illustrations belonging to clinical medicine, but cases of this nature occasionally require some investigation before poisoning, malicious or otherwise, can be excluded.

(*b*) **Idiosyncrasy.**—On this subject Dr. Taylor wrote:—

Certain kinds of animal food are found to produce occasionally symptoms resembling those of irritant poisoning. In some instances this poisonous effect appears to be due to idiosyncrasy, for only one person out of several may be affected. These cases are of importance to the medical jurist, since they may give rise to unfounded charges of criminal poisoning. In the absence of any demonstrable poison, we must test the question of idiosyncrasy by observing whether more than one person is affected, and whether the same kind of food given to animals produces symptoms of poisoning. If, with this latter condition, several persons are affected simultaneously, we cannot refer the effects to idiosyncrasy; they are most probably due to the presence of an animal poison. Among the articles of food which have caused symptoms of irritant poisoning **shell-fish** easily hold the first place, and of all the varieties of shell-fish none have so frequently given rise to accidents as the common mussel. The symptoms which it produces are uneasiness and sense of weight in the stomach; sensation of numbness in the extremities; heat, dryness, and constriction in the mouth and throat; shivering; difficulty of breathing; cramps in the legs; swelling and inflammation of the eyelids and face; a profuse secretion of tears; and heat and itching of the skin, followed by an eruption known as urticaria from its resemblance to the swellings caused by the sting of a nettle. These symptoms are sometimes accompanied by colic, vomiting, and purging. They may occur within ten minutes or a quarter of an hour; but their appearance has been delayed for twenty-four hours. There is generally great exhaustion and debility.

"A man ate about twenty mussels. He soon began to have nausea and griping pains. In half an hour he vomited and was purged several times. He then felt faint and dizzy. When seen two hours and a half after eating the fish he was collapsed, and the pulse was almost imperceptible, though not much increased in frequency, The pupils were natural. There was loud wheezing and rattling respiration, interrupted by frequent yawnings and sighings. Notwithstanding free stimulation with brandy, the patient was continually fainting; and he had frequent attacks of clonic spasms of all the muscles of the body. He was calm and conscious, had no pain, but complained of great thirst. There was itching of the skin, and an erythematous rash on the chest. Under the administration of opium and ether this condition speedily passed off" (*B. M. J.*, 1882, 1, p. 939).

The symptoms are not, however, invariably those of irritant poisoning.

A man who ate two or three quarts of mussels scraped off a vessel when admitted into hospital was absolutely unconscious. His face was livid, the pulse almost imperceptible, and he breathed only once or twice per minute by convulsive gasps. The pupils were widely dilated, and the reflexes abolished. Clearly he was asphyxiated, and died about ten hours after he was discovered in an unconscious state. Two other men suffered to a less degree at the same time (*Lancet*, 1888, 2, p. 568).

Segers has recently described a chronic form of mussel-poisoning among the inhabitants of Tierra del Fuego, who eat mussels, eleven to twenty-two pounds daily, almost to the exclusion of any other kind of food. The symptoms are marked icteric discoloration of the skin, enlargement and subsequent atrophy of the liver, and hæmorrhages from the mucous surface ushering in death. When the mussels are in good condition they are seldom injurious; but when they are thin they are often poisonous. Segers attributes this to the death of large numbers of mussels, their decomposition, the consequent promotion of poisonous ptomaines, and the absorption of these by the living mussels (*Presna* of Buenos Ayres, July 23rd and August 1st, 1891; *B. M. J.*, 1891, 2, Sup., p. 169).

The poisonous action of mussels can be referred neither to putrefaction nor disease, nor in all cases to idiosyncrasy, since in one instance those mussels only which had been taken from a particular spot were poisonous; all persons who partook of them suffered, and a dog to which some of them were given was killed. Brieger has obtained from poisonous mussels a poisonous ptomaine, *mytilotoxine*, to which he has assigned the definite formula $C_6H_{15}NO_2$, and to which he attributes the toxic effects of mussels ("Die Ptomaine").

A fatal case came under Sir Thos. Stevenson's notice in 1895, and another was the subject of an inquest at Bolton in February, 1904.

It is probable that in some at least of the above cases some of the other factors mentioned above came into play. Of other well-known foods which some people cannot touch, **strawberries, cheese,** and **eggs** are the best examples. The editor knows personal friends of his own who suffer severely from (even unconsciously) partaking of these articles.

Linseed can hardly be called a food, but for all that it is a food for domestic animals, and certainly one would have no dread of it if eaten, so that the following case is well worth recording as one of peculiar idiosyncrasy. It is published in the *Lancet*, 2, 1903, p. 1428, by Dr. Hollick, of Knowle:—

"The patient, a robust man, consulted me on May 19th, 1903, for an inflamed and protruding internal hæmorrhoid which had become strangulated by the external sphincter, and was giving him very severe pain. I ordered him to bed, and as he had already applied anodyne ointments and lotions without obtaining relief, I also directed a hot linseed-meal poultice to be applied to the inflamed and painful hæmorrhoid. This was done at about 3 p.m., and within four hours afterwards the patient experienced the following symptoms, which I have recorded in his own words:—

"'To commence with, I experienced a peculiar sensation in the throat and mouth, as though they were lined with velvet, the throat contracting considerably; there was a scaly feeling in the skin of the hands and feet. The skin all over my body, but more particularly on the thighs and legs, went "ansorino," having the appearance as though a small bladder of water surrounded each hair at its root; the skin changed to a colour between that of red and purple; after this the irregularities on the skin became more pronounced. My face was discoloured, and there was a rush of blood to my head. This discoloration of skin was accompanied by irritation. My hearing was affected. I went very deaf, and I was also unable to see well. My heart was beating very forcibly and rapidly, and I had a strong hysterical feeling. I counted my pulse, and timed it to be 120 per minute. I felt on the border of delirium. My chest seemed restricted, particularly at the lower part. These symptoms lasted about three-quarters of an hour, and on diarrhœa supervening they were very much mitigated. I then had an attack of vomiting, the vomit being of a dark colour, although I had taken nothing but milk foods for the past forty-eight hours. After this the symptoms gradually passed off, the velvety feeling at the throat and mouth being the last to disappear. On two previous occasions I had been "poisoned" by linseed. On the first occasion I was walking through a field in the east of England where labourers were engaged in the operation of stacking the linseed, and I ate a few of the seeds. Within three or four hours afterwards I experienced symptoms similar to those narrated above, only to a less degree. I ate about twelve seeds only, and the duration of the symptoms was from two to three hours. About two years afterwards I ate two lozenges of "linseed and liquorice," and the same symptoms were again experienced.'

"The patient sent for me at 8.30 p.m., and, as he resided some distance out in the country, I did not see him until 9 p.m.—*i.e.*, two hours after the commencement of the symptoms. He was then in a state of collapse, with quick and feeble pulse, a feeling of nausea, and with cyanosed condition of the face and extremities. His respiration was quiet, and the diarrhœa had ceased, but he had a marked condition of cutis anserina. He lay curled up on his side in bed, and was very prostrate; he at once told me that he had been poisoned by linseed, as recognised from his previous experiences. He was given an ounce of brandy in hot water, and hot bottles were placed to his feet and body; he passed a good night, and on the next day was in normal health again."

3. **Poison in the Food from the Plants on which the Food-giver fed or Metallic Irritant.**—The milk and cheese of some of the North American provinces is said to be occasionally rendered poisonous by the fact that cows pasture at certain seasons on vegetables of a noxious kind. In 1865, twelve cases of poisoning from this cause were reported. The symptoms came on in about three hours after the cheese had been eaten. There was severe pain in the stomach, cramp, violent vomiting of a greenish fluid, soreness of the throat, and a cold clammy condition of the skin. All recovered, recovery being preceded by profuse perspiration (*Edin. Med. Jour.*, 1865, 1, 854).

Vaughan attributes the poisonous character of decomposed cheese to a ptomaine, *tyrotoxicon* (diazobenzene butyrate), which has been isolated from poisonous cheese and milk.

As pork is sometimes salted in leaden vessels, lead may be found in it.

Poisoned game is now and again sold. The game may be quite free from putrefaction, but noxious from the poisoned grain which may have caused death. It is a common practice to steep grain in a solution of arsenic previous to sowing, and pheasants, partridges, and other birds may be accidentally destroyed by eating the grain. In some instances, grouse and other game are maliciously destroyed by the laying of corn steeped with arsenic, strychnine, or other poisons, in the localities where the birds abound. There is no law, except the Sale of Food and Drugs Act, 1875, to prevent the sale of poisoned game by poulterers, and there is no precaution which can be taken by the purchasers except by observing whether the birds have or have not been shot. (See on this subject "On Poisons," *Med. Gaz.*, vol. 42, p. 103.)

Mr. Taylor directed attention (September, 1862) to the serious symptoms produced by **Canadian partridges** eaten as food.

A lady who had partaken of this food was, in about two hours and a half, attacked with the following symptoms. She had sickness, and became insensible; the skin was cold, and no pulse could be felt. She was in a hopeless state for some hours, and only slowly recovered.

The birds were quite fresh, having been packed in ice. In another case there were similar symptoms, with constriction of the throat and great pain. Animals were made ill by this food. It was believed that, in these cases, the birds had not been killed by poison, but that their flesh had been rendered poisonous by some vegetable which they had eaten. It is stated that in some parts of Australia the **mutton is rendered poisonous** by reason of the sheep feeding on poisonous plants (*Med. Times and Gaz.*, 1871, 1, 728). Pheasants which feed upon the kalmia shrub are poisonous when eaten as food.

The **greening of vegetables** (*vide* "Copper Poisoning") is another illustration, and mutton is occasionally poisoned by mercury (*vide* p. 434). Tin and other metals in "tinned" foods, *vide* "Poisoning by Tin," p. 459.

For an illustration of poisoning by **honey** gathered from poisonous plants *vide B. M. J.*, 2, 1899, p. 674.

4. **The Symptoms arising from Specific Microbes in the Food.**—Of this class of illness from food, examples are only too common. Outbreaks of enteric fever have upon several occasions been traced to oysters and also to polluted water and milk. In fact, it is difficult, if we accept the specificity of its bacillus, to account for a *de novo* outbreak of the disease on any other ground than infection from a previous case, the discovery of so-called typhoid carriers does not invalidate the argument, but rather strengthens it, and certainly raw food, water, and milk are the commonest carriers of the infection.

In a similar manner scarlet fever and diphtheria have been upon many occasions traced to milk supplies.

This part of the subject, however, belongs too much to public health to treat it here with more than a simple mention; and the reader is referred to the public health records for further details, *e.g.*, Dr. Bulstrode's report on a typhoid fever outbreak following a mayoral banquet at Winchester and Southampton in 1903.

It is doubtful whether **pellagra** should be included amongst the diseases with a specific microbe; but the disease itself is a fairly well recognised entity, and is thus defined by Dr. F. M. Sandwith, who has had an enormous experience of it in Egypt and elsewhere:—"A chronic endemic, non-contagious cerebro-spinal disease of poor peasants, induced by the toxic action of **diseased maize**" (*Brit. Jour. of Dermatol.*, vol. 10, No. 121).

Lambroso thinks that the tetanic and narcotic action of extract of putrefied maize and its beneficial action on several skin affections point to the possible origin of pellagra in diseased or putrid maize. This would explain the prevalence of pellagra in the South European maize-growing countries, and assigns the cause to ptomaines.

5 AND 6. **Presence of Pathogenic and other Microbes and (or) their Toxins.**—In the cases below, as indeed in almost all cases of food poisoning, it is impossible to draw a hard and fast line between these two groups, for chemical analysis directed to the detection of ptomaines takes no account of the microbes causing them. It seems that many animal alkaloids are very little poisonous when administered experimentally, free from the microbes themselves, and bacteriology at least strongly suggests, that many, if not all, cases are really due to the actual microbes.

With regard to the chemical poisons that arise in decomposing animal matter, the following interesting summary by Sir Thos. Stevenson appeared in the last edition of this work:—

> Under the name of *ptomaines*, a class of bodies has within the last few years attracted the attention of toxicologists, and it will be well to summarise the observations which have led up to the discovery and recognition as a distinct class of these alkaloidal products of decay and putrefaction. A summary of the observations already published on this class of bodies was first given by Th. Husemann in the *Arch. der Pharm.*, an abstract of which is contained in the *Journal of the Chemical Society of London*, 1881, p. 57. Panum first showed that in the putrefaction of albuminous substances a soluble ferment is produced, insoluble in alcohol, withstanding the temperature of 100° C., and highly poisonous. Fagge and Stevenson also showed ("Proc. Royal Soc.," 1865; Guy's Hosp. Rep., 1865) that the alcoholic extracts of many post-mortem liquids, even after exposure to the temperature of the water-bath, are possessed of toxic properties. Bergmann confirmed Panum's observations, and described a definite body, *sepsine*, as a product of fermentatation. The researches of Panum and Schweniger showed, further, that at different stages of decay compounds varying in their physiological actions are generated. Sonnenschein and Zuelzer discovered in poisonous sausages, and also in an anatomical maceration fluid, a peculiar alkaloid resembling atropine in its physiological action; and they also noticed among the products of decay a substance which produced tetanic convulsions. The probable relation of these products of putrefaction to certain diseases is shown by the fact that Sonnenschein's alkaloid has been found in the bodies of patients dying from continued fever, and individuals who have eaten decomposed food and been poisoned thereby often show typhoid symptoms. Lambroso and Erba showed that decomposed poisonous maize produced tetanic symptoms, and that the maize contained alkaloidal bodies. The tetanus is sometimes associated with or masked by narcosis, and with this may be associated the observation of Ranke that the proper physiological action of impure strychnine extracted from putrefied corpses may be masked by ptomaines.
>
> These ptomaines closely resemble the vegetable alkaloids, not only in their physiological effect, but also in their chemical reactions. That the ptomaines are not exclusively post-mortem products has been shown by Spica, who obtained no less than four ptomaines from the fluid taken during life from a patient in a case of peritonitis; all were poisonous, though only one was so in minute doses, and the effects of this resembled curare. To the alkaloids produced during the normal changes during life Gautier has assigned the term *leucomaines*. It is undoubted, however, that besides ptomaines, non-alkaloidal, and probably more or less toxic, bodies are produced during putrefaction. These as well as ptomaines undoubtedly owe their origin to the action of microbes.
>
> Armand Gautier first divided the cadaveric alkaloids into leucomaines, or basic bodies which are the basic product of the normal metabolism of the tissues, etc., of the animal body, and ptomaines, or the basic products of putrefaction proper and bacteria.
>
> Gautier is of opinion that, far from being substances exclusively of cadaveric origin, they are normal and necessary products of the disassimilation of animal tissues, and that he has found very poisonous alkaloids (leucomaines) in normal urine. The researches of Bouchard on uræmia point strongly in the same direction, showing as they do that normal urine is more poisonous to rabbits than the urine of a man in uræmia. The urine of a patient affected with progressive paralysis, accompanied by increasing imbecility, yielded two bases, one resembling, but not identical with, nicotine, having a specific poisonous action, especially on the spinal marrow, destroying its activity, and diminishing the general sensibility, the respiration, and the pulsations of the heart. The other base resembled conine in odour. Luff has found an alkaloid in the urine of patients suffering from typhoid fever. There is great indefiniteness attached to most of the earlier descriptions of the ptomaines; and experimenters with them seldom commit themselves to statements of the quantities obtained or employed for physiological experiment. Obviously only very impure substances were separated.

By using extraordinary precautions in the separation and purification of the alkaloidal extracts obtained by Stas's process Sir Thos. Stevenson has convinced himself that the existence of poisonous cadaveric alkaloids in human viscera, even when putrid and diseased, is, to say the least, very rare. This conclusion is now universally recognised.

Six persons partook of tinned salmon for supper, and were all seized towards early morning with violent abdominal pains, sickness, headache, and profuse diarrhœa. The pupils were dilated, the temperature high (102° to 104° F.), the tongue dry, intense thirst, quick respiration, and a pulse of 110 to 160 per minute. One boy died; upon post-mortem examination the only noticeable appearance was congestion of the brain, and inflammation of the stomach and intestines. Luff, who made the analysis, could find no mineral nor animal poison in the viscera (*B. M. J.*, 1891, 2, p. 274).

Armstamoff has recently investigated eleven cases of poisoning from eating raw salt fish, and in six of these cases he made post-mortem examinations. The flesh of the fish contained an immense number of micro-organisms, and cultures of these produced in dogs the same symptoms as were observed in man. These were debility, abdominal pain, dyspnœa, dilated pupils, disordered vision, paralysis of the organs of secretion, dryness of the mucous membranes, inability to swallow, constipation, painful urination, and, later, vomiting. Occasionally there is gastro-enteritis. These symptoms supervene about twenty-four hours after the fish is eaten ("Centralbl. f. Bacteriologie u. Parasiten"; *Lancet*, 1891, 2, p. 113).

In 1892, a man died from eating tinned sardines. Sir Thos. Stevenson extracted from the fish an alkaloidal poison, a ptomaine, which proved fatal when administered to an animal (*B. M. J.*, 1892, 2, p. 1326) [possibly a pure case of ptomaines.—Ed.].

In December, 1903, a case of ptomaine poisoning whereby nearly fifty persons were affected occurred at Brewood, a village some miles from Wolverhampton. A large amount of potted brawn manufactured by a local grocer was sold to the residents, and the village chemist, who partook of the food, was himself taken very seriously ill. Mr. J. B. Brodie, headmaster of the National Schools, partook of the brawn, and became so ill that the doctor regarded his condition as very serious.

In 1892, the family of a working man at Tipton, Staffordshire, were taken ill after eating some tinned beef which was sold "on cut" from a local grocer's. They suffered considerably, and experienced all the sensations of poisoning from ptomaines. The tin was opened about 12.45 p.m., and half a pound was sold in one piece from the top of the tin to a woman who partook of a little herself and gave some to her husband, with some cold mutton, and also to her six children, the youngest, who was not taken ill, not eating any of it. There was nothing noticeable about the tin when it was opened, but the mother said that it tasted "stale." The tin was not "blown." The first case was a child three and a half years old, who was taken ill about two and a half hours after eating dinner. He was followed ten minutes later by the mother. Shortly afterwards the children were sent home from school ill, and the father had to return home from his work ill. All of them were suffering from the same symptoms: incessant vomiting, severe abdominal pains, with cramp, diarrhœa, cold sweats, followed by more or less of collapse. The children lay vomiting on the kitchen floor, perfectly helpless. The mother had lost all muscular power. The symptoms were urgent for about six hours, and gradually abated, leaving them next day prostrate but otherwise convalescent. Two neighbours who partook of the next slice of the meat were attacked with similar symptoms of less severity. On examination of the tin and the remainder of the meat it was noticed that the jelly and fat surrounding the meat was more liquid than usual, and that on one side and at the bottom it was much discoloured, of a very dark green colour, but not of a disagreeable smell. The meat in sections seemed to be perfectly normal. The under-surface of the tin corresponding to the discoloured parts was also discoloured. There was no hole noticeable in the tin. The symptoms were precisely those of severe choleraic diarrhœa.

We do not know enough about microbic disease to assert that these symptoms could not have been due to bacteria, but delay in the onset of symptoms is distinctly suggestive of definite development of microbes.

In 1887 a serious outbreak of disease occurred at Retford as the result of the use of a pork pie and bacon made from the flesh of a particular animal. Seventy persons suffered, of whom one died. The symptoms were those of acute gastro-enteritis. Klein submitted the pie and bacon to microscopical and bacteriological examinations, and by cultivation obtained micro-organisms (bacilli); and these, or the products of their action upon nutrient media, were fatal to mice (Seventeenth Rep. Local Gov. Bd., Sup.).

In March, 1893, a man died in Westminster Hospital after eating pork, which had no unusual appearances; several other persons who ate the same pork suffered in lesser degrees.

Sir Thos. Stevenson's conclusion was that the pork owed its toxicity to a ptomaine the product of bacterial life.

The reader is referred also to an article by Professor Mann on meat poisoning in the *Medical Chronicle*, July, 1896.

The following is a note taken from the *Lancet*, 2, 1903, p. 1519. The case is very much to the point as showing the work that medical officers of health and public analysts now have to do:—

"Of late years attention has been called from time to time to outbreaks or epidemics of typhoid fever through contaminated water supplies, such as those at Maidstone and King's Lynn, but a widespread epidemic of diarrhœa with a serious mortality commencing and ending suddenly as the cause came into operation and was subsequently removed on being discovered, like that recently recorded by Dr. J. C. Thresh, is extremely rare, if not almost unprecedented. It commenced suddenly on July 25th of the present year, and ended as abruptly on August 25th, having lasted just one calendar month, during which no fewer than 1,400 persons, of both sexes and all ages and classes, were attacked, and fourteen, of whom thirteen were young children, died. The area comprised a portion of the borough of Chelmsford and a single village within the limits of the rural sanitary district, each of which derived its water supply from the same source, in which no other section of the population, urban or rural, shared, and beyond the limits of the incriminated supply there was no excess of diarrhœa. The present year being remarkable for its unusually low diarrhœal death-rate served to emphasise the local incidence. An inspection of the waterworks showed that the supply was derived from several deep wells and distributed over distinct areas. In this particular locality the water was pumped from a deep and unimpeachable well into a small and uncovered reservoir. But the reservoir, instead of being surrounded by a parapet, was not raised above the level of the surrounding ground, and was therefore exposed to pollution by surface drainage and the entrance of storm waters during heavy rains. This actually took place in the storm of July 23rd, or two days prior to the occurrence of the first cases, the source of the trouble being evidently an adjoining plot of garden ground manured with road sweepings and the like. Though not followed by such grave consequences, the pollution of the tank or reservoir must have often occurred before, for it contained a deposit of soil and worms. While filter beds must be open to admit of the growth of the green felt-like film of confervoid algæ, to which their purifying action is almost wholly due, storage reservoirs, whether of unfiltered well or filtered river water, are better covered, especially should the water contain much calcium carbonate, if only to prevent the growth of the green malodorous chara; but if for any reason this is deemed superfluous a parapet should never be dispensed with, and this applies even more strongly to private than to public wells, they being constantly polluted from above."

Since Sir Thos. Stevenson wrote these lines an enormous amount of work has been done on the subject, but from the point of view of medical jurisprudence the results need not be discussed. The reader is referred to works on organic chemistry. Much useful information and an extensive bibliography may be found in "Ptomaines and Leucomaines," by Vaughan and Novy, Philadelphia, also Wells' "Chem. Path.," 1907, and Hurter's "Chem. Path.," New York, 1907.

It still remains a fact that many of the bodies extracted by chemical means from dead animal tissues of all kinds are found to be innocent of toxic properties, and some act as virulent poisons, but the latter are naturally in a minority, for, were it otherwise, the birth of all of us would very speedily be followed by our death, for the products of both anabolism and katabolism are constantly circulating in our blood, and the slightest derangement of excretory function would speedily give rise to dangerous trouble.

Suppose that some of these bodies were to be used for criminal purposes to destroy life, it would be beyond the reach of science to prove the fact, for the question must inevitably be put for the defence, "Could the poison you have asserted to be the cause of death have arisen in the body itself?" and by its very nature it is postulated that it could have done so.

7. **Presence of Worms.**—*Trichinosis.*—The fatal malady arising from the introduction of the *Trichina spiralis* into the human body has attracted much attention. Keller has published some important facts illustrating the symptoms produced, and the mode in which this parasite causes death. He considers that it is a question well worthy of the attention of medical jurists whether many cases of death from suspected irritant poisoning, in which no poisonous matter could be detected in the body, may not have been really due to trichina disease.

The symptoms produced by the use of such food are, in the first stage, those of intestinal irritation, loss of appetite, sickness, pain, general weakness of the limbs, diarrhœa, swelling of the eyelids and of the joints, profuse clammy perspiration, and wasting fever. Death is either the result of paralysis (from destruction of the muscular fibres), or of peritonitis and irritative fever. During the perforation of the coat of the intestines by these worms the mucous membrane becomes irritated and inflamed; pus is formed on its surface, and bloody evacuations are sometimes passed.

The noxious effects of this food on human beings are well illustrated by a series of cases which occurred at Hettstadt, in the Hartz mountains, in 1863 (*B. M. J.*, 1864, 1, p. 75).

> One hundred and three persons partook of smoked sausages made from a pig affected with trichinous disease. The sausages were fried, and served for dinner in the usual way. On the following day several persons who had partaken of this food were attacked with severe pain in the bowels, purging, loss of appetite, great prostration of strength, and fever. The number of persons attacked rapidly increased; symptoms of peritonitis and pneumonia appeared, and these were followed by paralysis of the intercostal muscles, and of the muscles in front of the neck. Eighty-three persons died from the effects of this noxious food, and the remainder were seriously injured in health. The remnants of sausage and of pork not eaten at the festival were examined, and were found to be swarming with encysted trichinæ (Casper's *Vierteljahrsschr.*, 1864, p. 286).

The writer in the above journal affirms that this parasitic disease does not attack sheep, oxen, or horses, and that beef is the safest of all descriptions of food, as no parasites have ever been discovered in it. They have not been found in the blood of animals whose muscles are liable to their attacks.

In suspected cases, if any of the food can be obtained, this must be examined for the parasite by the aid of the microscope. If the case proves fatal, the voluntary muscles of the deceased must undergo a similar examination. In the *Canada Medical Journal* for 1870-1, Edwards published a full account of the best methods of detecting trichinæ in the flesh of man and animals.

In some cases which occurred at Montreal the cause of the symptoms was at first obscure, but Edwards not only found trichinæ in a slice of ham which had been eaten, but in the muscles of two of the patients who recovered. He removed about five grains of muscular tissue from the gastrocnemius muscle, and twelve grains from the tibialis posticus. In both of these portions of muscle, about forty worms were found (*op. cit.* p. 517. See also Thudichum's "Report to Privy Council for 1864-5"). For further information the reader is referred to works on medicine and also on public health, the subject appertaining more to those branches than to forensic medicine.

Duration.—In all cases of single or multiple food poisoning there are very great variations in the time of onset of symptoms. Sometimes the victim is sick almost immediately after swallowing the food, and is at once seized with violent pain in the stomach; at other times an interval from half an hour to several hours may elapse before symptoms occur. When many people are poisoned by a common dish there is still great diversity in the time of onset of symptoms, which is not altogether easy to explain except on a physiological theory of varying resistances, and varying powers of the stomach for solution and absorption of the noxious substance. Again, several hours' delay is somewhat suggestive of the time necessary to the growth of enormous numbers of micro-organisms, and, as a consequence, that the symptoms are actually due to such rather than to an original dose of a chemical compound.

In those cases of infection by the germs of known specific diseases, variation in onset of symptoms is similar to the known variation in "incubation period."

Apart from these specific cases, the prognosis of which is that of the disease, death commonly ensues in a few hours, or the patient rallies from the primary shock. If he survives for seven or eight hours, and if vomiting and purging have been marked, danger is very much diminished, and may, except in young children, and debilitated subjects, be considered to have passed when the victim has survived twenty-four hours.

Toxicity and Fatal Dose.—Very little can be said on this head owing to the original doubt before analysis whether the symptoms are due to a chemical product with a fixed dose or to microbes that can multiply in the intestine (*vide* an address on meat poisoning by Dr. Durham, *B. M. J.*, 2, 1898, p. 1797, with experiments with meat infected with *B. enterididis* and *B. botuhinis*).

Of course, if atropine, lead, mercury, etc., be found the toxicity and fatal dose can be approximately stated.

So, too, if a ptomaine be isolated its lethal dose can be experimentally determined on animals, though that would not be of much much use in toxicology.

If, however, living microbes are in question, then all that can possibly be said is, that in the very vaguest manner the actual number gaining access to the alimentary canal, or to the tissues of the host, does have an influence on the severity of the symptoms, a severity which varies with (*a*) the vitality of the microbes, (*b*) their essential toxic powers, and (*c*) the powers of resistance of the invaded host.

Symptoms.—In groups (2), definite poison, mineral or vegetable, (3), specific infection with period of incubation and (6) worms, the symptoms are those of the specific cause, and must be looked for elsewhere.

In groups (1), (3), and (4), which constitute food poisoning in its ordinary sense, the symptoms are moderately uniform in character, though not in onset. They comprise nausea or vomiting, varying in severity, pain in the abdomen, which may be so severe as to cause collapse or faintness, and also diarrhœa, more or less profuse. If these symptoms are all severe, there soon develops a condition of extremely critical collapse, pulse rapid and feeble, breathing jerky and spasmodic, a cold clammy perspiration, and in fact a condition of cardiac failure but a little removed from death.

At an inquest in April, 1904, before Dr. King Houchin, on a child, æt. 3, poisoned by ice-cream, the mother stated that the child was seized with severe illness, and she ascertained that he had been eating ice-cream from a barrow in the street. She took him to a doctor. The sickness continued, and deceased complained of great thirst. Subsequently he became convulsed and died suddenly. Dr. J. W. Lynch deposed to finding the infant in a collapsed condition. In his opinion death was due to ptomaine poisoning set up by eating ice-cream.

Treatment.—Dr. Luff states that soluble biniodide of mercury acts as an antidote to most toxic ptomaines (*B. M. J.*, 1, 1890, p. 834), and such may therefore be given. The "Extra Pharm." gives (p. 287) the following formula for a mixture that might be employed in suitable age doses:—Liq. Hydr. Perchlor. ♏xxx.; Pot. Iod. gr. x.; Ammon. Carb. gr. v.; Decoct. Cinchonæ ad ℥j. In addition to this, stimulants and warmth will be required, and the general treatment of acute gastro-enteritis, which is what the cases practically amount to.

Post-mortem Appearances.—In the ordinary summer diarrhœa and vomiting of children, the editor has for years been teaching that an extreme thinness of the coats of the bowel is the only thing that even in any degree suggests the disease. It is probable that this is really ptomaine (or microbe) poisoning, and that its post-mortem appearances are those of the trouble we are considering. There may, in some of the cases, be signs of inflammation of the alimentary mucous membrane. If this be absent, as it often is, there will be no other appearances to point to the cause of death.

Analysis.—If any question is raised regarding a death taking place under such circumstances the analyst's work to be complete must be very laborious. He has to test for all metallic poisons (*vide* previous pages). He must next go through the complete process for the extraction of alkaloids (p. 352), and submit his results to a whole series of tabular experiments. Since ptomaines present in general the leading properties, physical and chemical, of the vegetable alkaloids, such as veratrine, morphine, and codeine, they may readily be confounded with these.

The proper mode of distinguishing between the two classes of bodies is to determine all the chief chemical and physical properties of the isolated base, and to compare these with those of the vegetable alkaloid whose presence is suggested.

The symptoms may of course give a clue, so that to the skilled analyst there are many short cuts; but the reader must be referred to all the analytical pages throughout this work.

Amongst the ptomaines which have been isolated are *putrescine*, *cadaverine*, *neurine*, *collidine*, *mydaline*, *tetanine*, *mytilotoxine*, and a host of others, some poisonous, others inert.

L. Brieger ("Die Ptomaine") has described the largest number of ptomaines. He finds that Stas's process for their extraction from organic mixtures is not applicable to the larger number of ptomaines, and recommends their precipitation by aqueous and alcoholic solutions of mercuric chloride.

The formation of ptomaines being universal in corpses when undergoing slow decomposition, it might be presumed that they would be frequently observed in the bodies of persons who have died from acute arsenical poisoning. Selmi has succeeded in demonstrating that under these circumstances peculiar arsenical poisonous bases (arsines) are formed. In 1878 he reported two cases in which poisonous crystalline ptomaines were found in exhumed bodies containing arsenic. The first subject was the body of a person exhumed fourteen days after burial, in a good state of preservation, containing much arsenic. In the search for alkaloids a small quantity of an alkaline substance, having a sharp bitter taste, was found. It reacted generally as an alkaloid. It afforded several colour reactions; but the amount of material did not suffice for a complete chemical and physiological examination. Shortly afterwards Selmi obtained larger quantities of a ptomaine from an arsenical corpse exhumed a month after death. This base had likewise a sharp bitter taste. Its chemical reactions differed somewhat from those of the previously described alkaloid. It was highly poisonous when administered to a frog.

Though in these two ptomaines the presence of arsenic was not proved, Selmi afterwards discovered organic arsenical bases (arsines) in the stomach of a pig which had been preserved in a solution of arsenic. The tissues were not destroyed, and there was no putrescent odour perceptible. The liquid yielded, on distillation, an alkaline distillate which yielded crystals with hydrochloric acid. These, when moistened with caustic soda, exhaled an odour somewhat resembling trimethylamine. The presence of arsenic was ascertained in the hydrochlorate of this volatile base, which yielded some alkaloidal reactions. Experiments made with twenty-four milligrammes (0·36 grain) of the substance showed it to be highly poisonous, and that it resembled strychnine in its physiological action. From the solid matter a volatile alkaloid was further extracted, but its small quantity prevented an accurate examination being made. From the residue of the distillation of the ether used in extracting these bases a third and non-volatile base was obtained, having a cadaverous odour. Its hydrochloric solution had an offensive odour and a bitter taste. It caused tingling when placed on the tongue, followed by loss of sensibility. The base yielded alkaloidal reactions, and contained arsenic. It was poisonous to frogs, but its action differed from that of the volatile arsines, and was somewhat similar to that observed as the ordinary action of the poisonous ptomaines. Torpor, paralysis, and stoppage of the heart in systole were the most prominent symptoms. The alleged existence of arsenical ptomaines is highly important, not only to the medical jurist, but as affording a possible explanation of chronic arsenical poisoning produced by arsenical wall-papers, if Selmi is correct in his assertion that a volatile arsine is produced by the contact of arsenious acid and albuminous substances possessing a highly poisonous action differing from that of arsenious acid. Husemann thinks it likely that a similar product may be formed from the size employed in affixing the arsenical paper to a room, the moisture of the air playing a part in the formation of the arsine.

Selmi's researches may, as Husemann thinks, throw light upon an obscure page in the history of toxicology. It is asserted that the poisoners of the seventeenth and eighteenth centuries, Toffa and other professionals, understood how to make arsenic more potent. In Italy, the *acquetta di Perugia* was, according to tradition, a secret compound prepared by rubbing white arsenic into the flesh of a pig, and collecting the liquid which dropped from the flesh. It is possible that the activity of the arsenic was increased both by the formation of readily absorbable compounds of arsenic with the inorganic alkalies, and by the formation of arsenical bases. The same object may have been in view in preparing *aqua Toffana*, with the addition, as is known, of the juice of the ivy-leaved toad flax (*Linaria cymbalaria*). Selmi and Vella are of opinion that in the *acquetta di Perugia* the concealment of the action of the arsenic on the one hand, and also of the tetanising poisons on the other, was accomplished; but this opinion, which is based upon an observation of Vella in a case of poisoning with arsenic and strychnine, does not accord with observations made on warm-blooded animals with a mixture of arsenite of potassium and strychnine, whereby the tetanising action of strychnine was not prevented, provided the alkaloid was given in poisonous doses.

GROUP 10.—MISCELLANEOUS POISONS.

POISONING BY MECHANICAL IRRITANTS.

Various substances which act mechanically may, when introduced into the alimentary canal, result in death, *e.g.*, powdered glass, diamond dust, and dried sponge, or sponge soaked in grease (*Lancet*, 1892, 2, p. 1309).

The editor has been unable to find any recent case of the kind, nor has he been able to find the case referred to by the *Lancet*, but the paragraph is worth reproduction as tending to elucidate the present position:—

> "We understand that a case is shortly to come before one of the criminal courts in America which will be of unusual interest. A woman is charged with the murder of an aged husband by feeding him with glass ground up in an ordinary coffee mill. The glass is thought to have been given in oatmeal porridge. This method of poisoning is supposed to have been a favourite one in the sixteenth century, and is said to be still practised amongst savage tribes who have access to the needful material. Medical literature, however, contains but few recorded cases. Glass may be a 'noxious substance' by virtue of the *mechanical* injuries which it can

produce, but is not therefore a poison in the legal sense of the word. A case of this nature with reference to previous observers is recorded in the *Edinburgh Medical and Surgical Journal* for 1824, p. 225. Dr. W. Turner, of Spanish Town, Jamaica, there relates that an attempt was made by a negro woman to poison a whole family with pounded glass. The persons on whom the attempt was made were seven in number, and none of them suffered any inconvenience. In the *Midland Medical and Surgical Reporter*, 1828, p. 47, Mr. William Hebb, surgeon, of Worcester, records in considerable detail the case of an infant who was destroyed 'by some person or persons administering to it a quantity of roughly pounded glass.' A considerable quantity of gritty powder, proved to be powdered glass, was found in the stomach, which 'was lined with a thick layer of tenacious mucus which was streaked with blood, and it required to be peeled off before the villous coat beneath could be exposed to view. This last was in a state of amazing vascularity.' Another case is reported in the *Allgemeine Wiener Medicinische Zeitung*, 1863, 8, 244. A case of attempted suicide by this means is recorded in the *Boston Medical and Surgical Journal*, 1871, p. 191. A young girl, aged sixteen years, desiring to end her life, pounded up a small glass bottle into fragments of the size of a split pea and under. Of these she swallowed a teaspoonful, taken at several times in bread. Although she experienced considerable pain and discomfort, she subsequently recovered. The favourable result may have been due to the bread protecting the stomach and intestines from injury. The small number of cases on record and the immunity which experimenters have enjoyed from harm after swallowing powdered glass would show that death produced by these means is not nearly as common as the remarks usually to be found in medico-legal text-books would lead the reader to imagine. In an inaugural dissertation published in Paris in 1830 by Le Sauvage, it is stated that two and a half drachms were given to a cat without injury, also that a dog took six or seven ounces in eight days without any symptoms manifesting themselves. Le Sauvage himself swallowed a considerable number of similar particles without sustaining any inconvenience. Professors Baudelocque and Chaussier in 1808 reported a case at Paris in which the prisoner was supposed to have poisoned his wife with pounded glass. This substance was actually found in the stomach of the deceased, and this organ as well as the intestines exhibited signs of great irritation. After a careful consideration of all that had been written on the subject, however, they gave their opinion that pounded glass is not a poison, and suggested that the glass in the stomach was derived from some vessel of that material being broken by her teeth during the convulsions which preceded death" (*Lancet*, 1, 1899, p. 174).

The only contribution the editor is able to make is to draw the reader's attention to the somewhat numerous cases that have occurred in surgical practice of the removal of every conceivable object from the human stomach. Spoons, coins, forks, bits of chain, nails, tacks, etc., etc., have all at different times been evacuated by operation.

Poisoning by Coffin Dust.

Surely of all curious substances to be used for a poison this must be the most so, and must show the mixture of superstition in human nature, which will survive all science. The fact of an alcoholic extract proving fatal to rabbits warrants the editor nevertheless in publishing this letter, which is one written by Dr. Percy Smith to Sir Thomas Stevenson in November, 1895. The publication of it here may bring fresh material to light:—

"I was conversing with a doctor from Columbia (South America), and he told me that in this country it was a popular belief that the *dust* of a decomposed body gathered from an old coffin was poisonous, producing, after ingestion, diarrhœa and death.

"A case had happened where a husband, being jealous of his wife, procured some 'coffin dust' from a grave, and administered it in soup. A fortnight afterwards the woman had diarrhœa and died. The doctor was called in at the trial of the man (some three months after the death) to advise the court if coffin dust was really toxic. He, being unable to answer the question, requested three months in which to make experiments.

"Accordingly he procured some dust from a coffin which had been buried about six years, the contents of which were quite friable—grey powder [it would appear that exhumations are frequent; I suppose the space for burying is limited]—and administered the same per os to dogs and rabbits *without result*, but an alcoholic extract injected into a rabbit was fatal.

"He thereupon professed himself unable to decide the question, not being a toxicologist, and because further experiments were necessary.

"The question is, 'Can the ptomaines survive the decomposition of the body, and exist unimpaired in the residuum?'

"The possibility of a definite poison having been administered together with the dust is negatived by the fact that the natives thoroughly believe in the efficacy of the dust, and would not trouble to get it unless they did so."

POISONING BY PROPRIETARY REMEDIES AND QUACK MEDICINES.

The following lists of patent medicines, etc., with their principal ingredients, though very imperfect, are not without interest. The first list is from the editor's lectures; the second is a list prepared by Dr. Robert Hutchison (*vide B. M. J.*, 2, 1903, p. 1654):—

Battle's Vermin Killer.—Strychnine, arsenic, and phosphorus.
Burnett's Fluid.—$ZnCl_2$.
Correctives for Women.—Either aloes, or ergot, or pennyroyal, or else perfectly harmless.
Fly Papers.—Arsenic, also in wall-papers, and occasionally in the highly coloured papers in which sweets are wrapped (a most pernicious practice).
Godfrey's Cordial.—Morphia.
Hair Washes and Face-paints.—Mercury, lead and bismuth, or chlorine, or hydroxyl.
Headache Remedies sold by Chemists as proprietary.—Phenacetin, antipyrin, antifebrin, etc.
Matches.—Phosphorus.
Mother's Friend. }—Morphia.
Mrs. Winslow's Soothing Syrup. }
Oil of Bitter Almonds.—Hydrocyanic acid.
Paregoric.—Opium.
Pigments used by Painters, etc.—Chiefly lead.
Powders for dusting Infants.—Occasionally contain arsenic with starch and fuller's earth.
Proprietary Disinfectants.—Carbolic and its immediate derivatives.
Rat Paste.—Phosphorus.
St. Jacob's Oil.—Aconite.
Seigel's Preparations.—Aloes and saline aperients.
Sorrel.—Oxalic acid.
Teething Powders.—Calomel and opium.

Aperient and Liver Pills.

Beecham's Pills.—Aloes, ginger, and soap.
Baillie's Pills.—Aloes, colocynth, oil of cloves, and soap.

Bile Beans.—Cascara, rhubarb, liquorice and ol. menth. pip., coated with gelatine.

Cockle's Pills.
Barclay's Pills.—Aloes, colocynth, and rhubarb.

Carter's Little Liver Pills.—Podophyllin (gr. $\frac{1}{8}$) and aloes soc. (gr. $\frac{1}{3}$) in each pill.

Dixon's Pills.—Taraxacum, podophyllin, jalap, and soap.

Holloway's Pills.—Aloes, rhubarb, saffron, Glauber's salts, and pepper.

Page Woodcock's Wind Pills.—Aloes, ol. carui, and soap.

Scott's Pills.—Aloin and cascara, with a soap basis.

Whelpton's Pills.—Rhubarb, aloes, ginger, pulv. ipecac., and soap.

Saline Aperients.

Eno's Fruit Salt.—Sodium bicarbonate, tartaric and citric acids.

Lamplough's Pyretic Saline.—Citric acid with potassium and sodium bicarbonate.

Abbey's Salt.—Tartaric acid with sodium bicarbonate, magnesium sulphate, and sugar.

Cough Mixtures and Lozenges.

Keating's Cough Lozenges.—Ipecacuanha, lactucaria, squill, liquorice, tragacanth, and sugar.

Owbridge's Lung Tonic.—Balsam of tolu, oil of aniseed, and oil of cloves.

Balsam of Aniseed.—Contains aniseed and other ingredients with gr. $\frac{1}{10}$ morphine in every ounce.

Preparations for Gout and Rheumatism.

Eade's Pills.—Sodium salicylate, guaiacum, and aloes.

Gloria Tonic.—Colchicum, guaiacum resin, and sodium iodide.

Blair's Gout Pills.—The active ingredient is colchicum.

Preparations for Headache and Neuralgia.

Antikamnia.—Sodium bicarbonate, antifebrin, and (?) caffeine.

Bromidia.—Potassium bromide, chloral, hyoscyamus, cannabis indica, oil of aniseed, syrup, and water.

Bunter's Nervine.—Creosote, chloroform, camphor, balsam of tolu, and alcohol.

Kaputine.—Antifebrin and sugar (coloured).

Kay's Tic Pills.—Iron sulphate, quinine, and soap.

Preparations for Asthma.

Crevoisier's.—Belladonna, foxglove, stramonium, sage, and potassium nitrate in equal parts.

Hair's Cure.—Potassium iodide and tar water.

Plant's Cigarettes.—Leaves of stramonium, lobelia, and green tea.

Tucker's Cure.—Atropine, cocaine, hypo-nitrous acid, and various balsamic extracts, administered by means of an atomiser.

Remedies for Obesity.

Trilene Tablets.—Sugar and a vegetable constituent of unknown nature.

Grey's Specific.—Contains 47·2 per cent. of free sulphur and a bitter (? gentian).

Mrs. Frost's Anti-Obesity Remedy.—The active ingredient is extract of fucus vesiculosus.

Russell's Anti-Corpulent Cure.—Citric acid (twenty grains to half an ounce), glycerine, and water. The pink tablet contains the saccharine.

Cosmetic Applications.

Mrs. Allen's Hair Restorer.—Lead acetate, milk of sulphur, scented with oil of cinnamon.

Tatcho.—Purified oil of paraffin and essential oil of lemon.

Koko.—Borax, glycerine, and rose water.

Harlene.—Glycerine, alcohol, ammonia, and oil of cassia.

Mexican Hair Restorer.—Lead acetate, precipitated sulphur, glycerine, and water.

Ointments and Liniments.

Cuticura.—Vaseline and oil of bergamot.

Elliman's Embrocation.—Acetic acid, turpentine, and white of egg.

Holloway's Ointment.—Turpentine, resin, olive oil, lard, wax, and spermaceti.

Homocea.—Camphor, oil of cajuput, and lard.

St. Jacob's Oil.—Oil of turpentine, ol. succini, soft soap, and capsicum.

Lineel Liniment.—Zinc and magnesium chlorides with glycerine.

Singleton's Golden Ointment.—An imitation of ung. hyd. nit. dil.

Miscellaneous Preparations.

Buer's Piles Cure.—Ointment of galls, and hamamelis with lanoline basis; the powder contains precipitated sulphur, and magnesium carbonate.

Californian Syrup of Figs.—Senna (active constituent), syrup of figs, and cinnamon.

Doan's (Backache) Pills.—(1) White-coated aperient (dinner pills), podophyllin, aloin, rhubarb, and peppermint; (2) brown-coated (backache), oil of juniper and a resinous constituent (? benzoin).

Guy's Tonic.—Phosphoric acid, tinct. cocci, infusion of gentian, and chloroform water.

Dalby's Carminative.—Pulv. rhei., magnes. carb., glycerine, sugar, ol. menth. pip., and ol. anethi, and a small quantity of laudanum.

Chlorodyne.—Chloroform, ether, hydrocyanic acid, morphine, cannabis indica, capsicum, peppermint, treacle.

Clarke's Blood Mixture.—The active constituent is potassium iodide (about six grains to the ounce).

Oxien.—Powdered sugar and starch, and ol. gaultheriæ.

Ozerine.—Potassium bromide and ammonium iodide with chloroform water.

Pink Pills.—Iron sulphate, an alkaline carbonate, and liquorice, thickly coated with sugar and coloured with carmine.
Phospherine.—Quinine, phosphates, and hypophosphites.
Seigel's Syrup.—Aloes, capsicum, liquorice, and treacle.
Steedman's Teething Powders.—Calomel and starch.
Warner's Safe Cure.—Potassium nitrate (about ten grains to the ounce) and various diuretic herbs.
Woodward's Gripe Water—Liquor. magnes. carb., ol. anethi, sugar, and a trace of alcohol.

Drink Cures.

Mrs. Terry's contains sugar (98 per cent.), salt (2 per cent.).
Antidipso.—Potassium chlorate and sugar.

The British Medical Association has issued a very full list of Quack Remedies in book form which should be read by every one who does not wish to be swindled or poisoned by such. It has gone very rapidly through two or three editions.

A CHAPTER ON MEDICAL JURISPRUDENCE IN INDIA.

BY

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In this chapter attention is drawn to those aspects of medical jurisprudence which will more especially interest practitioners of medicine in India and other parts of the East under British rule. The facts, figures, and experiences here noted do not come within the average experience of practitioners in temperate climates.

The medical witness in India is confronted with special difficulties in his attempt to get at the truth in criminal cases. These have been well summarised by Waddell ("Medical Jurisprudence for India," p. 14, ed. 1904):—

(1) Rapidity with which decomposition destroys dead bodies in the hot climate;

(2) Facilities for concealing and destroying dead bodies, together with the general practice of rapid cremation or burial within a few hours after death;

(3) Insufficient particulars of the crime in the police reports accompanying the alleged assaulted person, or a decomposed dead body;

(4) Untrustworthiness of so much native evidence, owing to the wide prevalence of false swearing and fabricating false charges.

1. **Rapid decomposition** often renders the autopsy not only a difficult, but a very trying, operation for the medical officer. It is, nevertheless, his duty to perform it as thoroughly as possible. In some cases the result will be that no certain clue will be found; in most, however, it is possible to determine at least the cause of death.

A dead body which has come into the hands of the police has to be carried in the hot weather, covered up with a cloth and wrapped in a piece of bamboo matting, for many miles—thirty, forty, or even sixty—to the nearest medical officer who alone is authorised or competent to make the medico-legal examination. There may have been delay before the body was found, there almost certainly has been delay after the body was found, and as the body is sent in, either by country carts or carried swung from a pole by two coolies, at a rate of about two or three miles an hour, it is easily understood how in the blazing sun or in the still Indian "hot weather" night the process of decomposition may be well advanced before the body reaches the mortuary. It is comparatively rare, however, for a body to be too decomposed for the medical officer to be unable to find the cause of death. Even in the damp warm climate of Calcutta this plea is but seldom used. In a series of over thirteen hundred cases examined at the Alipore Morgue only thirteen were reported to be "too decomposed" for the purpose.

2. The second difficulty is **the rapid cremation or burial of bodies**. The bodies of Hindus who die are cremated, and the bodies of Mahometans are buried on the day of death. Even in cases of Europeans and in the cold weather it is seldom that a funeral takes place much later than twelve hours from the time of death. But besides these legitimate methods of disposal of bodies there are many others in India. Bodies are easily concealed in rivers, wells, swamps, pieces of jungle, or among the standing crops. In such places the body is soon found by jackals, crows, dogs, or if in a river by crocodiles, fish, etc., and is soon mangled out of all recognition.

3. Again, the police report which accompanies the body gives the medical officer a few particulars as to where the body was found, but it rarely gives him any clue to the cause of the injuries, and the vague statements of "believed to have been beaten," or such-like, are often contradictory and not improbably false, or, to put it mildly, vague and misleading.

4. The fourth difficulty is **the falseness of much of the evidence** given by natives of India. It is a disputable point how much of this is due to "inherent Oriental deceit," as one author puts it, or to fear, stupidity, apathy, or malice, or to the fact that the witnesses have been "tutored" by the police. Such false charges are generally supported by wonderfully minute direct or circumstantial evidence; in fact, it is owing to the evidence being often too good that it is suspected and found to be false.

It would be a great mistake to imagine that the Indian criminal is a monster of iniquity; the vast majority of them are mild and somewhat simple men. In the Punjab and on the frontier the violent criminal is to be found, but the "habitual" criminal of an Indian prison is usually merely a habitual thief. Murderers are often mild and inoffensive-looking men, and indeed they are very frequently what the school of Lombroso calls "criminals by passion"; that is, they have attacked or assaulted their victim not as the result of long premeditation, but in a moment of passion, roused by some outrage done by the victim to some member of the murderer's family. Any large prison in India will be able to produce a dozen or more such cases, and they are generally well-behaved and quiet in prison. There are, however, other cases where the moral insensibility displayed is so inhuman and unnatural that in the European mind the utmost indignation is aroused; *e.g.*,

> A master murdered his servant and dragged the body to the door of his enemy solely in order that a charge of murder might be brought against the latter: a father murdered his daughter, because his neighbour had slandered her, in order that her blood might be upon the neighbour's head.

This moral insensibility of the natives of India is well known, and is illustrated in other cases, as in their apathy during accidents or assaults or when they calmly look upon the struggles of a drowning man, or as in a case seen by the present writer where a group of Mahometans would not stir to lift out of the way a small native child who sat playing in the middle of the road, though a runaway horse and trap were rushing down the road, and though their attention was called to the child and to the runaway horse in ample time to save life.

THE ONSET OF CADAVERIC CHANGES IN INDIA.

The classical experiments on this point were undertaken in 1883 in Calcutta by Dr. Coull Mackenzie, for many years police surgeon in Calcutta.

It is obvious that it may often be a matter of the greatest importance to ascertain the hour of death. Hence a study of the time of onset of cadaveric change becomes a necessity for the medico-legal expert.

Mackenzie's observations were made in a large hospital in Calcutta in the months of July, August, and September (average aerial temperature 85·5° F.), and in October (average temperature 81° F.) (*Ind. Med. Gaz.*, 1889, p. 167, etc.). The bodies were those of patients who had died of chronic disease in the hospital. The following is a summary of the observations made by Mackenzie (Waddell's "Medical Jurisprudence," p. 73):—

Changes, onset of.	Average.		Earliest.		Latest.	
	H.	min.	H.	min.	H.	min.
Muscular irritability lasts from death	1	51	0	31	4	30
Rigor mortis begins	1	56	0	40	7	0
Ditto, duration of	19	12	3	0	40	0
Green discoloration appears	26	4	7	10	41	0
Ova of flies appear	25	57	3	20	41	30
Moving maggots appear	39	43	24	18	76	0
Vesications appear	49	34	35	0	72	0
Evolution of gases	18	17	5	50	34	30

These observations may be compared with those of Assistant Surgeon Purna Chander Singh, of the Patna Medical School, which are reported in detail in the *Indian Medical Gazette* for June, 1902, p. 234. These observations were made in the very hot months of May, June, and July at Patna, a very hot place :—

Case 1. Female, aged forty-two. Body examined twenty and a half hours after death. Body swollen ; vesicles on arms, neck, and chest; brain soft and pulpy ; vesicles on surface of lungs, heart, liver, kidneys, and uterus decomposed. Date 9th May, 1901. Maximum temperature 105° F. ; minimum 79° F.

Case 2. Hindu male, aged thirty, died of assault. Body examined fifteen hours after death. Abdomen distended ; brain soft; other organs slightly decomposed. Maximum temperature 85° F. ; minimum 71·5° F. Date 21st October, 1900.

Case 3. Hindu male, aged forty, beaten to death. Body examined twenty-six hours after death. Abdomen distended ; vesication on leg and thigh ; brain soft; lungs, heart, etc., discoloured and softened. Date 30th May. Maximum temperature 86° F. ; minimum 76° F.

Case 4. Hindu male, aged forty, died of fracture of skull. Body examined forty hours after death. Cuticle detached ; bullæ on different parts ; eyes swollen ; tongue protruded ; fæces had escaped from anus ; hair of head easily detached ; brain reddish, soft or pulpy ; lungs decomposed ; blebs on their surface ; liver, spleen, etc., soft and decomposed. Date 2nd July. Maximum temperature 92° F. ; minimum 77° F.

Case 5. Hindu male, aged forty-five. Body examined forty-one hours after death. Body swollen; blebs; cuticle detached; fæces escaped; brain very soft, and could not be removed entire; all organs decomposed. Date 1st September. Maximum temperature 88·3° F.

Case 6. Hindu male, aged thirty-five, died of peritonitis after an assault. Body examined thirty-two hours after death. Body swollen; blebs on abdomen; face swollen; tongue protruding; fæces escaped; all organs discoloured and softened. Date 15th March. Maximum temperature 85° F.; minimum 57° F.; mean 69° F.

The writer adds:

"The soft pulpy condition of the brain, on account of which the organ could not be removed entire from the skull, occurred in Patna within twenty and a half hours of death in May, within thirty-one hours in June, thirty-seven hours in July, and forty-one hours in September." It may be noted that May is the hottest month in the year at Patna, as from June to October the rains sensibly modify the fierceness of the heat.

These observations therefore show that decomposition sets in early in the hot weather in India, and advances with a rapidity quite out of the experiences of European medical jurists (*vide* Vol. I.).

Under certain conditions putrefaction and decomposition may not take place; but the body may undergo the post-mortem change known as saponification.

SAPONIFICATION, WITH FORMATION OF ADIPOCERE.

[This has already been fully discussed (*vide* Vol. I.). The following cases are, however, valuable as facts.—Ed.]

Some years ago Mackenzie, then police surgeon of Calcutta, published eight cases, and I have been able to collect three more bearing on this question.

The eleven cases are, briefly, as follows:—

1. A body was found in an advanced state of saponification on removal from a tank where it had lain for "several days."

2. The body of a groom, exhumed from a damp Mahometan burial-ground four days and four hours after interment, was found to be in an advanced state of saponification.

3. A Chinawoman disinterred seventy-six hours after burial was also found in an advanced state of saponification.

4. A Bengali was drowned in the river Hoogli, the body was recovered after three days, and the internal organs were found saponified.

5. The body of a European, two days in the water, was examined, and all the external portions of the body were found to be saponified.

6. The body of a European sailor was recovered from the river eight days and ten hours after drowning. The external parts, the heart, liver and spleen, were found saponified.

7. The body of a sailor recovered from the river on the fifteenth day was found to be in an advanced state of saponification.

8. The body of a European youth was recovered after having been in the river seven days; it was in an advanced state of saponification.

To the above eight cases of Mackenzie I may add three more recent ones:—

9. D. M. Moir's case. A body was exhumed after having lain in a damp grave, at the depth of three feet, on the side of a lake. The body was so much saponified that Moir was able to completely confirm the previous post-mortem examination. The soil in which the grave had been dug was damp, being saturated with the rain of the previous three months' monsoon.

10. The tenth case is recorded by Dr. R. S. Ashe. The body was that of a boy, aged nine, exhumed four days after burial. The skin of the abdomen, chest, and extremities was found to be mottled and waxy-looking, and free from offensive odour. Portions were sent to the chemical examiner, Calcutta, who reported that

"partial saponification had taken place in the tissues." This opinion was also confirmed by the Professor of Pathology at the Medical College, to whom the specimens were also submitted for opinion.

11. The assistant surgeon s.s. *Mitra* informed Gibbons that in December, 1897, he had examined a case of saponification of the entire body, which from the history must have been buried within three months.

In view of the above eleven cases, it is scarcely possible to hold to the European view that a long period of weeks and months is necessary for the formation of adipocere.

MUMMIFICATION,

or the desiccation of the body, may also occur in India, not in the damp heat of Lower Bengal, but in the dry sandy deserts of Upper India.

AGE.

In India, children from seven to twelve years are deemed incapable of committing a crime unless they have attained a certain degree of maturity of understanding (I. P. Code, ss. 82, 83). Sexual intercourse with a girl under the age of twelve years is rape, according to the law of India, even if she consents, or is the individual's own wife (I. P. Code, 375). In other cases of kidnapping or enticing for purposes of prostitution, the question may arise as to whether the girl is over or under sixteen years of age. Under I. P. Code, s. 90, only a person over twelve years can give valid consent to suffer harm from any act done in good faith.

The requirements of the Indian Factory Act may also necessitate the determination of the age of a child, as no child under seven shall be employed, and children between seven years and twelve shall work not more than nine hours a day, shall have one hour for rest and four holidays per month.

The only published records bearing on this point which are specially derived from observations on natives of India are those by Powell published in the June issue of the *Indian Medical Gazette*, 1902.

[Powell's table of dentition closely approximates to that given in Vol. I.—Ed.]

Powell also remarks: "The first molars appear with great regularity in the sixth or seventh year. Of forty-one children aged seven, all had their first permanent molars. . . . All nine-year-old children, natives, Jews, and Parsis, had had all their permanent incisors." The canines show greater variation. They usually appear in the eleventh to twelfth year, but Powell has seen permanent canines in a child of nine. The second molars come with great regularity in the eleventh or twelfth year. He has "never seen a Hindu or Mussulman child of twelve without the second molars." He has also seen wisdom teeth as early as thirteen years and two months.

RELATION OF HEIGHT TO WEIGHT.

There are no observations published on the relations of height and weight according to age for the peoples of India. The following table, compiled by the present writer from weights and measurements of 28,000 male adult prisoners admitted into Bhagulpore Central Gaol, may be given. It is closely allied to a similar table which was compiled on the same lines at Nagpur, in the Central Provinces, and may be taken to represent the average height for weight of the peasant population of the part of Bengal known as Bihar:—

Height.	Weight.	Number of Observations.
5 ft. 0 in.	100 lbs.	1,863
5 ,, 1 ,,	102 ,,	2,059
5 ,, 2 ,,	106 ,,	5,226
5 ,, 3 ,,	109 ,,	5,787
5 ,, 4 ,,	112 ,,	6,107
5 ,, 5 ,,	115 ,,	3,040
5 ,, 6 ,,	118 ,,	2,498
5 ,, 7 ,,	121 ,,	1,389
5 ,, 8 ,,	125 ,,	623
5 ,, 9 ,,	129 ,,	220

The average weight of a Bihar peasant may be taken to be 110 lbs., and his average height 5 ft. 3 in.

What has been called in India "Buchanan's formula" for calculating weight for height is as follows:—

"Taking 5 ft. as equal to 100 lbs., add 3 lbs. in weight for every inch above 5 ft., *e.g.*, 5 ft. 5 in. = 100 + (3 × 5) = 116 lbs."

In the case of men over 5 ft. 8 in. in height it was found that the addition of 4 lbs. for each inch gave a weight which was not far from correct.

RACIAL DIFFERENCES IN THE SKELETON.

This has been worked out in detail by Dr. Havelock Charles, of the I.M.S., Professor of Anatomy in the Calcutta Medical College. His observations (published in "Transactions of Indian Medical Congress," 1884) were, it is understood, made in the dissecting room of the Medical School at Lahore, in the Punjab. These might well be of importance in the case of the disappearance of a European in India, and the production of bones by the police:—

Spinal Column.—"As a rule the body of a Punjabi's lumbar vertebra is thicker behind than in front. As the bone matures with age the excess of the posterior over the anterior depth becomes more pronounced.

"In the female the anterior measurement is greater than the posterior. . . .

"The fifth lumbar vertebra is only exceptionally wedge-shaped, as in the European.

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"Up to age of twelve none of the typical changes have taken place, but the deepest part of the body of a lumbar vertebra is behind and not, as in the European, in front."

The lumbar curve is straight or very slightly convex. Ninety-six is the index for the European lumbar curve (Turner), 106·8 for the native of the Punjab.

The accessory processes of the fifth lumbar vertebra are frequently largely developed in the native, and often articulate with the alæ of the sacrum.

The articular surfaces of the sacrum I found in 78·7 per cent. of cases to be formed of only two vertebræ. In European sacra this is formed of three vertebræ (Macalister).

Acetabulum.—The differences are:—

1. In natives of India the ischial portion of the facies lunata is very large. The rim of the acetabulum here is very prominent, and the groove for the obturator externus muscle is consequently deep.

2. The extension forwards and the widening out of the lower horn of the facies lunata, whereby the cotyloid notch is, as it were, partly bridged over instead of being an irregular open space. It looks as if the transverse ligament were ossified on its ischial side.

3. The cotyloid notch, which in the European bone is, as a rule, open, presents in well-marked Indian bones the characteristic of being arched over by the forward and upward prolongation of the inferior cornu of the facies lunata. The superficial boundary of the cotyloid notch in Europeans consists of the transverse ligament alone; the same boundary in the Indian consists of bone (part of the ischium plus the transverse ligament).

The Head of the Femur.—The articular area is of greater extent relatively and absolutely than that of a European bone. The surface is specially prolonged to adapt itself to the modified facies lunata of the acetabulum during extreme flexion and partial abduction, and during semi-flexion and extreme abduction occurring at the hip-joint in the squatting and sartorial postures.

The Neck of the Femur is longer relatively than in the European.

The upper surface of the internal condyle of the femur is partly articular. This is not so in the European, where it is merely rough for the insertion of the gastrocnemius. It is due to the power of extreme flexion possessed by the Oriental knee joint.

The Head of the Tibia is set on the shaft very obliquely. An Oriental tibia can easily be held by the finger and thumb when the internal tuberosity is grasped behind by them.

The upper surface of the internal tuberosity slopes considerably downwards and inwards; it is never flat, as in European bones.

The external tuberosity of the tibia has its condylar surface convex from before backwards, and the articular surface is well prolonged downwards posteriorly.

The upper part of the tibial diaphysis is commonly directed obliquely backwards.

On the anterior margin of the **lower extremity of the tibia** a facet will be found in most cases on what is the ligamentous area of the European bone.

In upwards of 17 per cent. of tibiæ a second facet on the same border, but occupying a more internal position, will be seen. Both these articulate with corresponding articular areas on the upper surface of the neck of the astragalus.

The Astragalus differs considerably from the European. There is a facet on the upper surface of the neck to the outer side; there is a facet on the same surface more internally, which is continuous posteriorly with the trochlea, and internally with the pyriform malleolar surface.

The outer margin of the neck of the astragalus is markedly thinner than in the European bone. *The Under-surface.*—In the European bone the deep concavity, or articulation with the large convex facet on the upper surface of the os calcis, is generally bounded by two sharp non-articular margins. In Oriental bones the outer margin is frequently articular on its inferior aspect, as this part, when the facet exists, articulates with the upper surface of the greater process of the os calcis.

The Os Calcis.—On the upper surface of the great process there is often amongst Orientals a facet continuous with the large posterior articular surface of the body of the bone, whereas this surface is rough in European bones.

The Skull.—For practical purposes it may be assumed that most male Indian skulls have a cubic capacity of 1,360 cc. or under, whereas the European male skull runs to 1,500 cc. and upwards. The measurement of the cranial capacity can be made by mustard seed, easily procurable, when small shot is not available. Dr. Charles also points out that it is rash to assume that the bones of an Oriental are necessarily smaller than those of a European. Many large, tall "up country men" have large bones.

WEIGHT OF VISCERA.

The following table has been compiled by the present writer from his own observations, and others made by Dr. R. Maddox, I.M.S., upon adult male prisoners in Bengal, who had died of disease in prison :—

NATIVE MALES.

	Number of Cases.	Average Weight.	Highest.	Lowest.	Causes of Death.
		Oz.	Oz.	Oz.	
Liver . . .	333	44	108	13	—
Spleen . . .	314	10½	64*	1	*Malarial.
Lung, right . .	224	16	52†	5	†Pneumonia.
,, left . .	224	14½	43	5	—
Heart . . .	238	7½	20‡	4	‡Apoplexy.
Kidney, right .	246	3¾	8	2	—
,, left . .	246	3¾	8	2	—
Brain . . .	143	44	56	33	—

NATIVE FEMALES.

	Number of Cases.	Average Weight.	Highest.	Lowest.
		Oz.	Oz.	Oz.
Liver . . .	88	37½	62	16
Spleen . . .	91	6½	48	1
Lung, right . .	49	9½	20	6
,, left . .	49	9½	17	4
Heart . . .	46	6	9	4
Kidney, right .	68	3½	6	1
,, left. .	68	3½	6	1
Brain . . .	7	37	42	26

VIOLENT DEATHS.

The largest number are due to accident; then comes suicide, and lastly homicide.

SUICIDE.

Dr. Kenneth McLeod published a valuable monograph on suicide in India. From this it appears that in Bengal and the Punjab the reported average annual suicide rate for the five years which ended 1876 was in Bengal 31·3 and Punjab 12·7 per million of the population; in Madras it was 62 for males and 68 for females; in the United Provinces of Agra and Oudh 27·8 for males and 71 for females; in Calcutta it was, males 64, and females 104 per million. In India the female suicide rate always exceeds that of males, the reverse being the case in England.

Kenneth McLeod also gave the following table on the various methods of suicides per thousand of the two sexes *in Calcutta*:—

Method.	Males per Thousand.	Females per Thousand.
Hanging . .	179	346
Drowning . .	127	54
Poison . .	547	562
Cuts and stabs .	59	16
Gunshot . .	37	—
Otherwise . .	51	22

From this it is seen that in that city the favourite means of suicide is poison, but this does not apply to other parts of the country.

The following table is compiled from four provinces in India:—

Methods of Suicide in India per Thousand Suicides in each Sex.

Method.	Males.	Females.
Hanging . .	368	278
Drowning . .	354	576
Poison . .	168	119
Cuts and stabs .	65	11
Gunshot . .	25	—
Otherwise . .	20	16

From this it will be seen that male would-be suicides prefer first hanging, then drowning, and then poison, while females far and away prefer drowning, then hanging, and next poison.

The chief causes of suicide are shame, grief, physical suffering, revenge (Chevers), and from religious motives, as in the now abolished [illegal—a trial arose on a case in 1905 (*vide Lancet,* February 18th, 1905)—Ed.] custom of *sati*, where the widow threw herself on the funeral pyre of her deceased husband.

HOMICIDE.

The causes which lead a man to murder another are often in India trivial in themselves: quarrels about land, murder for the sake of robbery, such as the ancient *thuggi* and the more modern form of *datura* poisoning, and murder arising from outrages done to husband or to wife.

INFANTICIDE.

The special causes why infanticide is common in India are the restrictions placed upon the remarriage of Hindu widows. Such women are deprived of their husbands often at a very early age, and are exposed to temptations, without any choice of remarriage. This leads to the destruction of the offspring of illicit intercourse. Among certain classes in India it is considered necessary to have all the daughters of a family married. This is not always possible, and is always expensive; hence a certain amount of female infanticide is practised.

Chevers has recorded a case where, because three successive female children were born, the father exposed the last born child in the jungle. Chevers also records that in a special inquiry ordered by Government into the practice it was found that in twenty-six villages out of 308 no female child under the age of six existed. In another Rajput village 104 boys and only one girl were found, in another 284 boys but only twenty-three girls.

According to the law of India, a child is alive or in being from the moment any part of the child has been brought forth, though it may not have breathed or been completely born. "The causing of the death of a child in the mother's womb is not homicide" (I. P. Code, s. 299).

Section 315 of the Indian Penal Code also says :—

"Whoever before the birth of any child does any act with the intention of thereby preventing that child from being born alive, or causing it to die after its birth, and does by such act prevent that child from being born alive, or causes it to die after its birth, shall, if such act be not caused in good faith for the purpose of saving the life of the mother, be punished with imprisonment," etc.

According to Indian law, proof of respiration amounts to proof of live birth, except in those rare cases of vagitus uterinus; such cases are usually those in which instrumental aid has been necessary for the extraction of the child from its mother's womb.

CRIMINAL ABORTION.

Criminal abortion is resorted to in most countries, but is said to be very common in India and is largely due to the non-remarriage of Hindu widows.

Sections 312, 313, 314, 315, and 316 of the Indian Penal Code deal with the question of criminal abortion, and lay down the penalty which may be inflicted for the offence.

According to these sections, the consent of the mother is a most important point. Such consent is held to mitigate, and absence of such consent to aggravate, the offence, whereas according to English law such consent is immaterial.

The methods of producing abortion adopted in India are usually crude, and frequently lead to loss of life. It is impossible to obtain statistics of the degree of prevalence of this offence, as it is only the fatal cases that come to the notice of the police. If the case recovers, the pyrexia is attributed to malaria, and if the woman dies, and a complaint is not immediately lodged, the body is burned or thrown into the river.

The methods are either mechanical or medicinal.

Mechanical.—A very common method is by the use of "abortion sticks." Those commonly used are twigs of *Plumbago Rosea*, *lal chitra* in the vernacular, or of the oleander, *Nerium Odorum*. These sticks are five or six inches long, and are passed into the uterus either through the membranes, or between them and the wall of the uterus. It not infrequently happens that the wall of the uterus is thereby perforated, with the result that peritonitis supervenes and death follows.

In other cases the "stick" used is not in itself an irritant, but it is smeared with some irritant substance, as the juice of marking nuts (vernacular *bhela*), *Semicorpis Anacordium;* the juice of jequirity (vernacular *rati*), *Abrus Precatorius*, or *modar*, the milky juice of *Calotrophis Gigantea*, a common wild plant in India.

Medicinal.—By the use of many indigenous drugs, which are credited with ecbolic or emmenagogue properties, as papaya seeds (*Carica Papaya*), carrot seeds, aloes, croton oil, mercury, quicklime, copper, or even the juice of bamboo leaves. Not infrequently a combination of more than one method is used, as indeed is the custom in other countries than India.

INJURIES IN GENERAL.

In the Indian Penal Code "murder" is differentiated from "culpable homicide" and from causing "death by doing a rash or negligent act."

Sections 299 to 309 of the Penal Code deal with these offences. Culpable homicide is thus defined (section 299):—

> "Whoever causes death by doing an act with the intention of causing death, or with the intention of causing such bodily injury as is likely to cause death, or with the knowledge that he is likely by such act to cause death, commits the offence of culpable homicide."

The following illustrations are added:—

> "A. knows Z. to be behind a bush; B. does not know it. A., intending to cause or knowing it to be likely to cause, Z.'s death, induces B. to fire at the bush. B. fires and kills Z. Here B. may be guilty of no offence, but A. has committed the offence of culpable homicide. Again, A. by shooting at a fowl, with intent to kill and steal it, kills B., who is behind a bush, A. not knowing that B. was there. Here, although A. was doing an unlawful act, he was not guilty of culpable homicide, as he did not intend to kill B. nor to cause his death by doing an act that he knew was likely to cause death."

Culpable homicide is murder if the act by which death is caused is done with the intention of causing death, or with the intention of causing such bodily injury as the offender knows is likely to cause death, or if the bodily injury intended to be inflicted is sufficient, in the ordinary course of nature, to cause death. Culpable homicide is not murder if the offender, whilst deprived of the power of self-control by grave and sudden provocation, causes the death of the person who gave the provocation, or causes the death of any other person by mistake or accident, provided that the provocation is not sought nor voluntarily provoked, or that the provocation is not given by anything done in obedience to the law, or that the provocation is not given by anything done in the lawful exercise of the right of private defence.

Hurt and Grievous Hurt.—The medical officer is frequently called upon to decide if a certain injury is 'hurt' or 'grievous hurt.'

Section 319 of the Indian Penal Code defines hurt thus—

> "Whoever causes bodily pain, disease, or infirmity to any person is said to cause hurt."

By section 320 the following kinds of hurt are called "grievous hurt":—

> (1) Emasculation; (2) permanent privation of the sight of either eye; (3) permanent privation of the hearing of either ear; (4) privation of any member or joint; (5) destruction or permanent impairing of the powers of any member or joint; (6) permanent disfiguration of the head or face; (7) fracture or dislocation of a bone or tooth; (8) any hurt which endangers life, or which causes the sufferer to be during the space of twenty days, in severe bodily pain or unable to follow his ordinary pursuits.

Sections 321 and 322 of the code deal with "voluntarily" causing hurt and grievous hurt.

When the police bring an individual to the medical officer for examination of an injury a form is produced, on which the police are supposed to state "all that is at present known of the case." On the back of this printed form are six columns with the following headings:—

1. Nature of injury, *i.e.*, cut, bruise, burn, etc.
2. Size of injury in inches, length, breadth, and depth.
3. On what part of the body inflicted.

4. Slight, severe, or dangerous.
5. By what kind of weapon inflicted.
6. Remarks.

This form also requests, if there is any fear of the case terminating fatally, or should unfavourable symptoms set in later, that notice be given to a magistrate, so that, if necessary, the dying declaration of the patient can be taken by the magistrate.

One of the most common weapons in use in India is the **lathi**, or bamboo staff, so frequently carried by all natives of India. It is often bound with iron or brass, and in the hands even of a feeble man it is and should be regarded as a "*deadly weapon.*" In 1872, Harvey calculated that 32 per cent. of all medico-legal cases in Bengal were due to injuries by blows of a *lathi.* In 1901, in the Arrah district alone Stevens has recorded that, out of 223 police cases, in 204 the injuries were caused by *lathi* blows, including twenty-four fractures of bones.

There is one form of severe contusion of the chest which is worth mentioning, as it is very likely to mislead the young medical officer. It is described by Chevers, and is known in the vernacular as *bansdola,* or bamboo crushing. A bamboo is placed across the victim's chest. Men sit on the ends of it, and roll it backwards and forwards over the chest. The torture is horrible, the muscles are bruised, but in practised hands *no external mark is caused* [*vide* Vol. I.—Ed.], though on post-mortem examination the ribs may be broken and the lungs lacerated. This torture may also be applied to the limbs, or the torturer may kneel with his two knees in the two "Scarpa's triangles" of the victim. Here also considerable local damage may be done to the vessels and muscles without any visible external marks.

INJURY TO ORGANS OF THE BODY.

The Spleen.

There is no special Indian experience on injury to, or rupture of, any organ of the body except the spleen.

Within the past couple of years a considerable amount of evidence has been forthcoming which shows that the enlargement of the spleen, which is so common in India, is the result of infection by what is known as "the Leishman-Donovan bodies," and as these have been shown by L. Rogers to be stages in the development of a trypanosome, it is clear that what has been called malarial enlargement of the spleen, or tropical splenomegaly, should be considered as a result of trypanosomiasis. It is probable, however, that repeated attacks of any malarial fever can *also* produce enlargement of the spleen, for it is certainly a very common sequel of such repeated attacks. From the medico-legal point of view the causation of the enlargement is, however, of small importance compared with its results, especially when they end in rupture.

Rupture of the Spleen is an injury which is rare in England, and, consequently, has received but scanty attention from writers on medical jurisprudence in the British Isles [*vide* Vol. I.—Ed.]. The reverse, however, is the case in India, where it is extremely common, and is constantly appearing in the law courts as the cause of death.

In fact, so common is it, that in the case of the sudden death of a native it might often be safely presumed that this was the cause. In the majority of those unfortunate cases in which a European is charged with having caused the death of a native by a blow or a kick, it is almost invariably found that the spleen was ruptured from a degree of violence which would have had no effect on a healthy person. A hostile newspaper went so far as to state that it did not believe in the existence of such an injury as rupture of the spleen—a statement based, I need hardly say, on the most absolute ignorance of the whole subject.

Rupture of the spleen, therefore, is a matter of the very greatest importance to the medical man practising in India, or in any other malarious country.

We have no statistics on a large scale as to the exact degree of the prevalence of enlargement of the spleen among the people of India; but such as have been compiled go to show that it is very considerable. Indeed, till recently an enumeration of the proportion of enlarged spleens in any community was used as a test of the malarial character of any locality.

In the European, the books on anatomy tell us, the spleen weighs from five to seven ounces. This is for Europeans whose average weight is usually taken at 150 pounds. The average weight of the native Bengalis, as the result of some 28,000 observations collected by me, is about 110 pounds only; but in them I found the spleen to weigh on the average ten ounces (average of 314 careful records.) The largest I have ever weighed was sixty-four ounces, that is heavier than an ordinary liver, but many larger than this have been found.

It is obvious that a large spongy organ, taking up much more than its proper space in the abdomen, is peculiarly liable to external injury and that, owing to the friability of the organ and the large quantity of blood it contains, such injury must almost always be fatal.

In an admirable article published (*Indian Med. Gaz.*, June, 1902), Dr. D. G. Crawford has analysed very thoroughly a series of 304 cases of ruptured spleen. These 304 cases were all taken from records of post-mortem examinations made for medico-legal purposes, and out of over 9,000 such records examined, the number of cases of ruptured spleen amounted to not less than 3 per cent. of the whole. Moreover, out of these 9,000 cases the spleen is noted as enlarged in no less than 37 per cent. and in some districts well over 50 per cent., of the spleens are recorded as enlarged. This means that more than one-half of the persons whose bodies come to be examined for the purposes of justice have enlarged spleens.

Following Crawford, we may discuss this question under several headings:—

Age and Sex.—Examination of statistics shows that there is but little difference between men and women in their liability to this injury; as regards age, nearly two-thirds were adults, that is, persons of an age most likely to be engaged in fights and quarrels.

The Cause of the Rupture.—Of the 304 cases, omitting 57 in which the cause is recorded as unknown and a few from miscellaneous causes to be mentioned below, we find 102 due to blows from sticks, 62 to blows of the fists or kicks, 22 to falls, chiefly out of trees, 2 to pressure on the body (a familiar form of torture), 23 as part of a murderous assault, and 20 to being run over or to a heavy weight falling on the body.

The miscellaneous causes recorded are of importance, as showing what a slight degree of injury may lead to a fatal result. Among them were a clod of earth thrown and striking the left side, the blow of a shoe, or a wooden stool, or the prod of a cow's horn. Others were, being knocked down (not run over) by a horse, the blow of a fall to the ground, or the kick of a horse.

The following cases may also be quoted :—

A European gentleman who slipped on the floor of his bathroom and died in a few minutes. At the autopsy the spleen was found to be ruptured and to weigh nineteen ounces. Even this simple fall caused no less than four lines of rupture. James has recorded the case of a shepherd boy who, while indulging in horse-play with another youth, fell and died in three hours. The spleen was found to weigh twenty-two ounces and to be ruptured in two places on the lower surface. In another case a Punjabi boy died after a blow which was ascertained to have been on the right side. The spleen was found enlarged, with a rupture one and a half inches long on the inner surface. James has also recorded another remarkable case of what he calls "spontaneous rupture" of this organ in the person of a Punjabi who, while conducting his own case in a law court, fell down suddenly. Not the slightest evidence could be obtained that he struck anything as he fell, but at the autopsy it was found that the spleen was much enlarged (weighing no less than three pounds thirteen ounces), and ruptured for six inches along its inner surface.

Two other cases of "spontaneous rupture" of the spleen have been published (*Indian Med. Gaz.*, 1904). These cases show that when the organ is diseased, the very slightest blow is sufficient to cause its fatal rupture, if indeed muscular action may not be by itself sufficient.

The Site of Rupture.—Of 262 cases where the site of the rupture was noted, 133 were on the inner surface, 55 on the outer surface, and 116 either on two surfaces or irregularly distributed. Of 304 cases 225 were single ruptures, and 79 were multiple. It appears therefore that the inner surface is by far the most commonly ruptured, and it is said that on this aspect the spleen capsule is the thinnest.

In all the above cases the spleen was recorded as more or less enlarged; but there were eight cases in which at the autopsy it was recorded as not enlarged. In these eight cases the injury was either severe or multiple (murderous assault or "run over").

A prisoner in a gaol either fell on some bricks or was roughly handled by another prisoner (the evidence was not decisive). At any rate the spleen was found ruptured, and it was described by the reporter as "healthy"; it was not markedly diseased nor enlarged.

It is, perhaps worth noting that in five of these eight cases the stomach is stated to have been found full, and in only one case is it said that the stomach was empty. Crawford, however, who has investigated this point, is of opinion that there can be found no very definite connection between rupture of the spleen and a state of fulness of the stomach.

Complications.—Of course, in cases of great violence it is natural to expect damage to other organs, but an analysis of Crawford's figures shows that in only thirty-two cases (10 per cent.) was any other organ than the spleen ruptured. In nineteen of these thirty-two the liver was also ruptured.

The Period of Survival after Rupture.—This is often a most important legal question. We may quote a few cases bearing on this point. In Russell's "Malaria: its Causes and Effects," a case is related in which a man received a severe injury to the spleen and recovered; but the injury to the spleen was confirmed some years after, when a post-mortem examination took place on his body. I have only been able to collect seven cases of survival for considerable periods after undoubted rupture of the spleen. Many years ago I published one such.

In four cases the victims survived over twenty-four hours, in one case for five days, in two cases for four days, in another case for two and a half days, in another a "few days," in another for three days. The longest period of survival that I have been able to find is that of a man admitted to a Calcutta hospital with a rupture of the spleen, and he remained there for seventeen days, and the injury was confirmed post mortem.

In some cases the period of survival is passed in unconsciousness, but in others there can be no doubt that the patient may be able to speak or make a dying declaration, etc., points often of the greatest legal importance.

A question may arise as to the possibility of a man with ruptured spleen being able to get up and walk a certain distance. This point is not often noted in recorded cases, but in reading them one frequently finds nothing that makes such impossible. Doubt is set at rest by the following case, published in 1867 by Dr. Hutchinson:—

> An old man, after having been severely beaten by a bamboo, walked to his home, a distance of about half a mile, and there died almost immediately. The post-mortem examination showed that the seventh and eighth ribs on each side had been fractured. The spleen was ruptured, and also the liver.

It is worth adding that a case has been published (*Indian Med. Gaz.*, November, 1903, p. 417) in which at an autopsy on a Sepoy, aged twenty-four, there was found a total (congenital) absence of the spleen, along with a transposition of all the abdominal and thoracic viscera.

Chevers has pointed out that rupture may occur in (1) simple engorged spleen, (2) enlarged engorged spleen, (3) the small hard fibrous spleen, and (4) the large hard fibrous spleen.

The so-called "ague cake" spleen is enlarged and often so fibrous and hard that it seems at first sight little liable to rupture, but in such cases a recent attack of fever may have produced engorgement, which would have the effect of making it softer and more friable.

THE PERIOD OF DIGESTION OF INDIAN FOODS.

Experiments to show the periods required for the digestion of foods have usually dealt with European foods, *i.e.*, meat, bread, and vegetables, and Dr. Beaumont's classical experiments still remain unchallenged, but it is to be noted that the periods given do not refer to the digestion of Indian foods in Indian stomachs, on which but few observations or experiments have been recorded, hence the value of the observations below.

The natives of India use either rice, wheat, or other grains as their staple food. In addition to this many use some of the pulses, and comparatively few eat meat, fowls, or fish. The people of Eastern Bengal, however, take a small quantity of fish, if they can procure it, at both of the chief meals of the day. Rice is largely consumed by the inhabitants of Bengal, Madras, and Burma, along with vegetables, fish, and pulses. In the United Provinces, and in the Punjab, rice is but little used. The people there eat chiefly wheat, maize, millet, and such cereals, cooked into unleavened cakes, or *chapatties*. The rice-eaters take a large quantity of this grain. Cooked rice weighs almost three times as much as dry rice, and an ordinary meal of a fairly well-to-do Bengal native consists of about twelve ounces of dry (about thirty-six ounces cooked) rice, a couple of ounces of dry pulse or fish, a few ounces of watery vegetables, and not less than a pint of water. The bulk of this is very great, and it is probable that the routine use of pan (betel) and other digestives is due to their power of aiding the digestion of such a bulk. It is obvious that it may be of the greatest medico-legal importance to know the exact time at which a deceased person died. One method of estimating this is by the state of digestion of the food in the stomach, presuming that the hour at which deceased took his last meal is known.

The following observations of Dr. P. C. Singh, of Patna, have been published at my request. They were made on bodies sent in for medico-legal examination:—

1. A Hindu, aged thirty-five, took food at 8 a.m. He was severely assaulted at ten o'clock (two hours later), and died at 2 p.m. from the effects of ruptured spleen. At the autopsy a large mass of undigested rice and pulse was found in the stomach. Death had taken place six hours after the last meal; but it is possible that the process of digestion may have been interrupted by the shock and hæmorrhage at ten o'clock.

2. A young man took food at 11 p.m.; he had an epileptic fit at 2 a.m., and died at 5 p.m. the next day. The stomach was found half full of undigested rice.

3. A man took his evening meal at 10 p.m., went to sleep soon after, was murdered in his bed at 5 a.m. (*i.e.*, seven hours after taking food). A small mass of undigested rice and potato was found, so that stomach digestion was not completed even in seven hours.

The following experimental observations were made by washing out the stomachs of healthy persons at fixed periods after taking food:—

1. Large meal of pulses, rice, and vegetables at 12 noon, stomach washed out after three hours. Some undigested rice remained.

2. Same person another day, stomach washed out after four hours. One ounce of undigested rice was recovered.

3. Same person another day. After five hours some undigested rice flowed out from tube (250 grains counted), and so up to seven hours, when even then some undigested grains of rice remained in the stomach.

4. A similar experiment on another man. Some 200 grains of rice, undigested, were found on washing out after five hours.

5. Similar experiment. Two drachms of undigested rice were found after six hours.

6. Same person fed on rice and chapatti (a sort of unleavened bread in the form universally used by up-country natives). After six hours some rice and a piece of the chapatti were found undigested.

In two similar experiments pieces of the chapatti, undigested, were found in the stomach after so long intervals as six hours and thirty minutes, and after six hours and forty minutes.

These experiments and observations seem to show that some portion of a meal of rice, pulses, etc., may be found undigested even six or seven hours after the taking of food.

INSANITY IN INDIA.

It can safely be said that, on the whole, insanity is less common in India than in European countries. It is certainly a fact that a very small number are sufficiently insane to need confinement in asylums. At the present time there are not more than 5,000 lunatics in all the asylums of India, and of its teeming millions the census returns show not more than 5 persons per 10,000 as insane; in these figures are undoubtedly included cretins and half-witted village idiots. There are no private asylums in India, and even in such a large province as Bengal, with seventy-seven million inhabitants, a central asylum for about one thousand inmates amply suffices for the needs of the population. About one-half of the lunatics in an Indian asylum are "criminal lunatics." In four provinces in India in one year about 850 patients are admitted to asylums. Of these considerably more than half are admitted under the heading of "mania," about one-fourth as melancholics, one-eighth as dements, and the rest under the other headings. The causes of insanity in India are the same as in every other country, viz., heredity and stress. It is of course very difficult in the case of the vast majority of illiterate insanes to obtain any reliable evidence as to the existence of any hereditary predisposition in the family, and it is still more impossible to trust the entries in the forms under the heading "Causes," which are usually filled up by semi-educated police subordinates.

Causes of Insanity.—1. *Heredity.*—The number of cases of insanity attributed to heredity in India is remarkably small. Out of 1,344 persons admitted to asylums in India in 1892 it was found that only fifty-eight, or 4·3 per cent., of them were attributed to heredity. This is in marked contrast with the 19 per cent. which is given by Hack Tuke for England.

2. *Other Causes.*—These are fever and sun exposure, sexual excesses, syphilis, grief, datura, alcohol, etc., but none of these except datura are of any special importance in a note on insanity in India.

Alcohol, it may be noted, is very rarely mentioned as a cause of mental disease in India. It is very little used by natives in India on the whole, though there is to be noticed a perceptible increase in the use of alcohol in the larger towns. The primitive tribes use alcohol freely in the form of home-brewed rice beer and toddy, but in no sense can the abuse of alcohol be looked upon as a national vice in India. It is probable that its place is taken by other drugs, such as opium, Indian hemp, and cocaine, which are consumed for their euphoric properties. In a certain collection of cases, however, 4 per cent. were put down as probably due to alcohol.

Opium.—The use of opium is very general in many parts of India. It is taken for its euphoric effects. As will be seen below (p. 855), it is a very common cause of fatal poisoning, but it has but little influence in the causation of insanity.

Datura.—This is a potent intoxicant, and produces a furious temporary delirium. For its use as a poison see below (p. 856). It is however, but seldom found to be a cause of insanity, unless mixed with hemp.

Indian Hemp.—Of all the causes to which insanity in India has been attributed the abuse of the hemp drugs is the most important.

In the year 1893, the Government of India appointed a commission to inquire into the cultivation of the hemp plant, the preparation of drugs from it, and the effect of their consumption on the social and moral condition of the people. This Commission visited all parts of India, and made elaborate and thorough inquiries, and published the results of its investigations in a report which with the records of evidence, etc., consists of seven large volumes. In this report is contained all that is known about the hemp drugs, their use and abuse, in India.

The two plants *Cannabis Sativa* and *Cannabis Indica* are apparently identical, "the Indian plant being viewed as an Asiatic condition of the species." There are no botanical characters to separate them, though the hemp plant is believed by the most competent Indian botanists to have been introduced from Central Asia, and not to be an indigenous plant, yet it now grows wild over an immense area throughout the Himalays from Kashmir to the extreme east of Assam.

The products of the hemp plant which concern us from a medico-legal point of view are **ganja**, **choras**, and **bhang**. Though these names are in some places confused or mixed, yet, generally speaking, the following definitions given by Prain, of the Calcutta Botanic Gardens, hold good:—

> "*Ganja* consists of the dried flowering tops of cultivated female hemp plants, which have become coated with resin, in consequence of having been unable to set seeds freely.
>
> "*Choras* is the name applied to the resinous matter which forms the active principle when collected separately.
>
> "*Bhang, siddhi, subsi, putti*, are different names applied to the dry leaves of the hemp plant, whether male or female, cultivated or uncultivated."

It must, however, be noted that the word *bhang* is commonly used for the liquid form in which the hemp drugs are consumed; *i.e.*, *ganja* pounded up and made into drink becomes the "bhang" of ordinary parlance.

The hemp drugs may be smoked, drunk, or eaten.

Smoking.—Ganja is chiefly used in Bengal. The ordinary method in Bengal is as follows: A small quantity of ganja is taken, one-sixteenth of a lota, and is kneaded in the palm of the left hand with the thumb of the right, a few drops of water being added if necessary. When it ceases to give any colour to the water it is ready to be smoked. The pipe or *chillum* is a bowl with a short neck, the same as that commonly used by natives for smoking tobacco. First a small foundation of tobacco is put into the pipe. On this is placed the prepared *ganja*, which has been chopped up. Then comes another layer of tobacco. A bit of live coal is placed on the charged pipe, and a damp cloth is generally wrapped round the neck of it and folded into the palm of the left hand, while the pipe is grasped by the neck between the thumb and first finger. A few short breaths are blown and drawn to light the pipe, and when this is done one long deep draught is taken into the lungs. The pipe is then handed on to a companion and goes the round of the circle.

In the Punjab and United Provinces *choras* is chiefly smoked, but *choras* is only smoked in Bengal by well-to-do people, on account of its expense. In the provinces just mentioned the *choras* is mixed with tobacco in the form in which tobacco is generally used by natives in their *hukka*. The draught is always taken into the lungs.

Ganja may also be smoked in the hukka, and even cigarettes may be made of the leaves, but usually the leaves are only used by very poor people in this way.

Well-to-do people, however, are not content with these simple means of smoking, and they prefer to mix with the *ganja* or *choras* certain spices, such as musk, mace, saffron, cloves, cardamoms, or rose leaves, etc. Sometimes even more potent drugs are added, as opium and datura. The use of datura, opium, arsenic, or nux vomica is, however, confined to excessive consumers, to whom the simple drug has ceased to give the required degree of exhilaration or stupefaction.

Methods of drinking Hemp Drugs.—As with smoking, so in the case of drinking, there is a simple or common form and other more elaborate compounds. The simple form is merely to pound the drug very fine with some black pepper, to add water (according to the desired strength of the drink) and filter the mixture through a cloth. For this purpose the leaves of the plant are generally used, or the leaves and the flower heads. This is the preparation commonly called in Bengal *siddhi* or *bhang*, and in other provinces usually *bhang*.

This drink may be fortified by the addition of harmless spices and perfumes, such as anise, fennel, coriander, dill, or cardamoms, or, to meet the craving of the excessive consumers, the drink may have datura seeds, opium, nux vomica, or arsenic added.

Eating.—*Ganja* and *bhang* (*i.e.*, leaves) are also eaten mixed with any of the spices mentioned above, or with *gur* (crude molasses), and swallowed in the form of a bolus. The practice of thus eating the hemp drugs is, however, much less common than either smoking or drinking them.

Another preparation is in the form of sweetmeats, called *majun*. *Ganja* and *bhang* (leaves), and more rarely *choras*, are used, the basis of the sweetmeat being sugar, milk, and spices.

Majun is largely used at certain Hindu feasts, and is evidently credited with aphrodisiac qualities.

The custom of offering an infusion of the leaves of the hemp plant to guests on religious festivals is almost universal in India. In fact, the use of *bhang* is intimately associated with many social and religious observances of the people, just as is the use of wine and spirits among European nations.

The above details have been given of the varieties and uses of these drugs, for considerable ignorance exists as to them, and it is not possible for a medical officer to make any inquiries as to their use in a case of insanity suspected to be due to this cause unless he has a clear notion of the customs of the people with regard to these drugs.

It may be remarked that there is a certain amount of popular prejudice against the smoking of these drugs. It is not quite respectable; at least respectable men do not smoke the drug in public, but usually in the privacy of their homes, and among friends and companions, and it is believed that on the whole smoking *ganja* or *choras* is more injurious than the drinking of *bhang*, but in considering the abuse of the drugs the question of the adulterants, especially datura, must always be borne in mind.

In discussing the question, 'Is the moderate use of the drugs beneficial or at least harmless?' we must clear our minds of prejudice. The fact is that the answer to such a question is the same as would be given by the average man to the same question about alcohol or tobacco. Neither alcohol, tobacco, nor hemp drugs are necessary. Moderation in their use does but little, excess certainly does much, harm.

It must also be remembered that hemp drugs are largely used for therapeutic purposes by Indian medical practitioners. They are often prescribed in bronchitis, asthma, and other respiratory complaints, and also as general and local anodynes. They possess a certain amount of diuretic action, and though modern research does not favour the view that they are also aphrodisiacs, yet such is a popular belief in India. The probability is that, like alcohol, they give strength and free course to the predominant desires of the animal nature. On the whole the balance of evidence is that the *moderate* use of hemp drugs is not injurious.

As regards the formation of a habit, in this respect hemp drugs are like any other intoxicant, consumption tends to become habitual. The habit is strong, but the difficulty of breaking it off is not so great as in the case of alcohol or opium, but probably greater than that of the tobacco habit. The immoderate or excessive use of the drug is chiefly of importance in regard to its share in the causation of insanity.

The report of the Hemp Drugs Commission, from which we have quoted, has gone very thoroughly into the relation between hemp drugs and insanity. There is no doubt that in the record of Indian asylums there were, and still are, a large number of cases which have been attributed to the excessive use of these drugs, but on examination of the records of cases in the asylums, the Commission proved clearly that, whatever may be the truth of the connection between hemp and insanity, the statistics of the asylums had no claim to be considered as trustworthy. It was proved in a large majority of cases that the entry of hemp drugs, under the heading of causation, in the asylum registers merely meant no more than that this "cause" was put down from the descriptive roll that accompanied the patient to the asylum, and that there was no better authority for the entry than that of the police subordinate who filled up the form. The Commission concluded that "excessive use indicates and intensifies mental instability, it tends to weaken the mind, and it may even lead to insanity." When taken in more than a moderate quantity, hemp drugs in any form produce a condition of intoxication, shown by laughing, singing, and other emotional actions. Hallucinations are produced, which are governed by the nature of the subject towards which the thoughts are most often directed. To the sensualist the effects are sensual, while the ascetic finds that his powers of contemplation are increased by a dose of hemp (Gibbons). In persons unaccustomed to its use the drug produces marked delirium with violence, or even mania. The stage of excitement lasts some hours; then the individual passes into a state of stupor (or, in rare cases, into fatal coma). After several hours recovery gradually takes place. The question then remains, Are there good grounds for the popular belief (shared by many medical men) in a close connection between the abuse of hemp drugs and insanity? J. H. T. Walsh has ably discussed this in the *Journal of Mental Science* (January, 1894).

His conclusions are as follows:—

"(1) That hemp drugs are very largely used in Bengal, smoked as *ganja* or *choras*, drunk as *bhang* or *siddhi*, or eaten as *majun*.

"(2) Among healthy persons *ganja*, smoked alone or with a very small addition of *datura* (two or three seeds), produces a condition varying from mild exhilaration to marked intoxication. The violent and intoxicating effects are less marked, or not seen at all, in persons having a regular and wholesome supply of food. Much the same may be said of *bhang*.

"(3) Among persons of weak mind, or with a marked neurotic tendency, even a moderate quantity or only a slight excess of hemp drugs may so increase the insanity, latent or evident, as to make such persons violent, morose, or melancholy, according to the neuropathy with which we start. The presence of adulterations such as datura will increase these effects.

"(4) Abuse of hemp drugs, especially when adulterated with datura, will produce even in healthy persons a very violent intoxication simulating mania, or may lead to a morose melancholic condition, or to dementia. These conditions are generally of short duration, and the patient ultimately recovers. So common is absolute recovery that I think when a patient confined in an asylum for the treatment of insanity, said to be due to the abuse of hemp drugs, does not recover within ten months, these drugs were possibly only the exciting cause, and that we are dealing with an individual who was either insane previous to his use of intoxicating drugs, or with one in whom latent insanity has been roused into activity by the vitiating effects of excess of ganja, bhang, etc."

Running Amok.—This is an expression applied to an impulsive act of reckless multiple homicide, without apparent or any real motive. The word *amok* is said to mean in the Malay language "frenzied." There is a popular impression that persons who "run amok" are in a condition of hemp intoxication. As shown above, no doubt abuse of hemp does produce a condition of violent mania-like intoxication, but there is little or nothing to show that the homicidal impulses of "amok" are in any way connected with the abuse of hemp drugs. No doubt murderers and thieves may often nerve themselves with hemp for the accomplishment of acts previously determined on, but this is only an Oriental form of "Dutch courage."

Chevers ("Medical Jurisprudence," 3rd ed., Calcutta, p. 781) quoted Dr. Oxley as dividing cases of amok into two classes: (1) cases where the motive is revenge for a real or supposed wrong, the assailant becoming perfectly reckless, and (2) the other form, very different and by no means so frequent. For instance, a man sitting quietly among his friends and relatives will without provocation suddenly start up weapon in hand and slay all within his reach. Dr. Oxley has known as many as eight killed and wounded by a very feeble individual in this manner. The next day when questioned why he did this he replied, "The devil entered into me; my eyes were darkened; I did not know what I was about." Dr. Oxley generally found these monomaniacs suffering from some gastric disease, these fearful ebullitions breaking out upon some exacerbation of the disorder. Dr. Oxley did not attribute this practice to the use of intoxicating drugs, and a more recent observer, Dr. J. D. Gimlette, agrees with this view. Gimlette considers "amok," as seen in Malays, to be pathological, and in some degree allied to the procursive form of epilepsy, in which the patient starts to run. There is always, he says, (1) sudden paroxysmal homicide, generally in the male, with evident loss of self-control; (2) there is a preceding period of mental depression; (3) there is a fixed idea to persist in reckless killing, due to an irresistible purposive impulse; and (4) there is a loss of memory of the whole attack.

FORMS OF INSANITY IN INDIA.

All forms of insanity are known and recognised in India, but general paralysis of the insane is very rare, though Europeans in India have been known to suffer from it. This is in accordance with the experience of other Oriental and African countries. General paralysis seems to be an affection due to the manifold influences of the higher forms of civilisation.

RESPONSIBILITY AND THE PLEA OF INSANITY.

The law of India on this point agrees with that of England, and is founded on the report of the English judges in the McNaughton case in 1843. Section 84 of the Indian Penal Code is as follows:—

> "Nothing is an offence which is done by a person who at the time of doing it, by reason of unsoundness of mind, is incapable of knowing the nature of the act, or that he is doing what is either wrong or contrary to law."

It is obvious therefore that according to law the test of responsibility is the knowledge of the nature of the act, and of right and wrong. The law takes no cognisance of the loss of the power of self-restraint, or of the irresistible impulses which are well known to medical men to be a feature in many forms of insanity [*vide* Vol. I., ED.].

Incapacity to Manage Affairs.—The procedure is laid down in Indian Act 34 of 1858 and Act 35 of 1858. Act 36 of 1858 deals with the reception and detention of lunatics in asylums. They can be received under the following conditions: if by order of a magistrate, commissioner of police, or civil court, with only one medical certificate. This certificate must give the grounds on which the opinion has been formed as follows:—(1) facts indicating insanity observed by the medical officer himself; (2) facts indicating insanity communicated by others [*vide* Vol. I., ED.].

A lunatic may also be received into an asylum in the presidency towns on the requisition of a relative or guardian (in form B). The medical certificate in this case must be signed by two persons, "each of whom shall be a physician or surgeon," and one of them must be "a surgeon in the employment of Government."

POISONING IN INDIA.

From times immemorial the use of poisons to remove objectionable persons has been very common in India. In a paper pleading for the restriction of the free sale of poisons in India, Drs. Evans and C. L. Bose stated that "murder by poisoning is three times as prevalent, and suicide by poisoning many times more prevalent, in India than in England."

TABLE OF PERCENTAGES OF FREQUENCY IN THE USE OF VARIOUS POISONS IN INDIA.

—	Opium.	Arsenic.	Alcohol.	Aconite.	Indigenous Vegetables, Datura or Nux Vomica, Hemp.	Kerosene.	Others
Bengal (ten years), 1884—1893, Waddell.	62	26	—	5	3	—	4
Some Indian provinces, 1884.	38·5	52·3	—	—	1·2	—	8
Punjab (three years), Chemical Examiner.	30	50	2	2	9	—	7
Calcutta Medical College, 1901, 142 cases.	86* cases.	?	22 cases.	?	?	9 cases.	25 cases.

* In considering statistics of the number of cases in which opium is found in the viscera in fatal cases of poisoning it must be remembered that many are not sent up to the Government Chemical Examiner, as the cause of death appeared obvious to the medical officer who made the post-mortem examination.

The crime of poisoning is dealt with under sections 284, 299, 304A, 324, 326, and 328 of the Indian Penal Code.

There is no restriction on the free sale of poisons in India, except by the Bombay Act 8 of 1866, which incorporates the provisions of the English Arsenic Act (14 Vict. cap. 13).

By the Bombay Act certain specified poisons may be sold only by licensed vendors to (*a*) persons known to the vendors, or in the presence of a witness known to both purchaser and vendor, or upon the written order of a person known to the vendor, or (*b*) when the poison is required for medicinal purposes on the prescription of a qualified medical man, or person known to the seller to be in good repute and practising medicine. It is also enacted that white arsenic shall not be sold in a state of powder, unless it be mixed with soot, indigo, or Prussian blue. These restrictions apply to the following poisons: (1) aconite, cocculus indicus, datura, henbane, nux vomica, St. Ignatius' bean, and calabar bean, and (2) white, red, and yellow arsenic, Scheele's green, Schweinfurth's green, and corrosive sublimate.

There is a great degree of sameness in the poisons used by the people of India for various crimes. For homicide, arsenic is by far the most commonly used, then come aconite and nux vomica, and (in cases of children) opium; for suicide, opium is used in a large majority of cases, then, much less frequently, arsenic; for stupefying previous to robbery, datura chiefly, and, more rarely, Indian hemp; for abortion, plumbago rosea and oleander.

In India the medico-legal examinations in cases of poisoning are made by the Government medical officer of the district, styled the civil surgeon, and at the headquarters of the subdivisions of a district by the Government medical officer in charge, usually an "assistant surgeon," or in some cases a "civil hospital assistant." The reports by the latter officers are sent to the civil surgeon of the district for him to record his opinion on the facts and inferences in the report made by the subordinate medical officers.

In the present chapter only the most important poisons used in India are dealt with.

ARSENIC.

There are many reasons why arsenic should be the chief poison used for homicide. In the first place, it is easy to obtain, for white arsenic may be purchased in every bazaar, as it has its legitimate uses—*e.g.*, as a preservative of wooden posts against the attacks of white ants, in the making of leather, and in curing hides and skins. It is also largely used for destroying vermin, and as a medicine in the treatment of syphilis, and in the more chronic forms of the malarial fevers. Secondly, the acute effects of the poison so much resemble an attack of Asiatic cholera that suspicion is unlikely to arise, especially if it happens that cholera is at all prevalent in the neighbourhood at the time.

All forms of arsenic may be used for criminal purposes, but white arsenic, arsenious oxide (As_2O_3), is the form most commonly employed. Its colour is white; it has but little taste when mixed with sugar, sweetmeats, bread, or rice, in which vehicles it is usually administered. White arsenic is called in the vernacular languages *somul* or *sumbhul*, and is largely imported from Hong Kong and Persia. In spite of considerable medical agitation in its favour, there is no Sale of Poisons Act in many parts of India, and indeed the experience of the province of Bombay, where such an Act was passed nearly forty years ago, is scarcely in favour of such legislation, on account of the difficulties of enforcement. By this Act the sale of arsenic was regulated by licence, and it was ordered that when pounded white arsenic was sold to the public it must be coloured with soot, indigo, or Prussian blue. That this enactment has been totally inoperative from a medico-legal point of view is clear from the statement of the Bombay Government Analyst that in the past thirty-two years there has not been met a single case in which the arsenic used for criminal purposes has been found coloured as directed in the Act.

The sulphides of arsenic are less commonly used for the purposes of crime in India. It is curious, too, that a very large proportion of the cases in which the sulphides have been used have been suicidal. In other instances arsenious oxide has been found mixed with the sulphates of iron and copper, and with the sulphide of mercury.

An important point in the criminal use of this drug, and one which often leads to its detection, is the enormous dose usually administered by the criminal to the victim. I have examined a case in which the quantity was so great that I was able to scrape it off the walls of the stomach with a knife.

The motives which lead to the use of arsenic for homicidal purposes are chiefly revenge and sexual passion. Husband poisoning is commonly effected by the use of arsenic, and in some cases it is certain that the powerful drug was only used as a "love philtre," or as an aphrodisiac, and with no criminal intent. It is also an undoubted fact that in times of cholera prevalence arsenic is used as a means of getting rid of an enemy, or a rival in the many disputes into which the land hunger of the Bengal peasant leads him.

Arsenic is less commonly used as an abortifacient, and usually with disastrous results. It such cases it is commonly applied as a mass of paste to the os uteri. It is seldom used for suicidal purposes, but when so used it is in very large doses—as much as 300 grains have been recovered in such a case, though, as said above, the mere fact of such enormous doses by no means negatives a homicidal view of the case.

Cases of accidental poisoning are not infrequent, owing to the common use of arsenic in the arts and as a medicine. I had charge of one case in which a native gentleman, who suffered much from fever, and could or would not take quinine, accidentally poisoned himself by the continued use of Fowler's solution in very large doses (♏. 40 to 80).

Arsenic is also very largely used as a cattle poison, though in the United Provinces its place is taken by the use of dried snake poison inserted under the skin on a piece of sharpened iron or wood.

In a few rare cases in which death from shock has resulted the stomach has shown no signs of congestion, and has even contained a large quantity of solid and liquid food, vomiting not having occurred.

In a series of 191 cases of arsenic poisoning four were recorded in which death took place within two hours, and in none of these was any congestion found. It would seem as if more than two hours' contact were required to produce the appearances of congestion.

As the decomposition of dead bodies is very rapid in a hot climate, it is important to remember that the so-called antiseptic action of arsenic is confined to the stomach and intestines, the other organs being as subject to rapid decomposition as in death from any other cause. Perforation of the stomach in arsenic poisoning is rare, but a few cases have been recorded in India.

The so-called "nervous cases" of arsenic poisoning are of importance, as they may be very misleading.

As an example may be quoted the case of a man, aged thirty, to whom a poisonous dose of arsenic was given. He suffered from giddiness, faintness, coma, and suffused conjunctivæ, but had no vomiting nor diarrhœa, and he recovered. In another case all the usual symptoms of irritant poisoning were present except purging.

The onset of symptoms in acute arsenic poisoning is generally rapid, that is, within half an hour. Bedford, an authority on Indian poisoning, gives eighteen to twenty hours as the average period which elapses before death, and states that 82 per cent. of cases die within the first twenty-four hours. On the other hand, cases are on record in which symptoms did not appear for fourteen hours, and death in the case of a single lethal dose has been delayed as long as nine days; and even longer intervals are recorded in European text-books. In some such cases the delay has been explained by the fulness of the stomach, by sleep, or intoxication by opium or alcohol.

In one case, however, recently recorded in India, where all such causes could be eliminated, no symptoms appeared for fourteen hours. Another remarkable case is worthy of mention where, in Bombay, a Parsi recovered after having swallowed "two masses" of arsenious oxide. He passed per rectum no less than 105 grains. His only symptoms were slight diarrhœa, drowsiness, and headache.

Arsenic is not invariably fatal even when taken in poisonous doses, for of eight consecutive cases treated at the Calcutta Medical College Hospital five recovered.

Opium.

The next most important poison in Indian medical jurisprudence is opium. It is calculated that 40 per cent. of cases of poisoning in India are due to this drug.

Opium is seldom used for homicide or for robbing; it is the drug *par excellence* for suicide. It is also not rarely used for infanticide. Owing to the frequency of the opium-eating habit, the drug may easily get into the hands of children, often with serious results.

Poisoning by opium is frequently met with in hospital practice. In 193 consecutive cases of poison treated at the Calcutta College Hospital there were no less than 165 due to opium, and of these 42 per cent. died. This high percentage of mortality, in spite of a most complete and ever-ready system of treatment, points to the fact that most of them were cases of determined suicide, in which large doses were taken late at night, and the victims were found in an advanced stage of poisoning in the morning.

In the above 165 cases crude bazaar opium was used, except in one, where the tincture was taken. We may note in passing that the large experience of the Calcutta Medical College Hospital is not in favour of atropine as an antidote in such cases.

The symptoms of opium poisoning are well known, but it is less recognised that vomiting and diarrhœa are sometimes present; tetanus and lockjaw symptoms have been observed in the case of children poisoned with opium, and the occurrence of such might well mislead the medical attendant.

Opium is usually swallowed, but in some parts of India suicide has been attempted by the introduction of opium into the vagina.

It is seldom possible to find out the exact quantity taken. Four grains is usually regarded as a lethal dose. On the other hand, recovery has taken place after even very large doses. A curious case has lately been published where seven grains of opium were taken along with croton oil. The symptoms were entirely those of an excessive dose of the oil, and as severe as if no opium had been taken.

Opium and its preparations are ingredients of a large number of patent and quack remedies; hence poisoning from it often occurs accidentally. One of the most important patent preparations containing opium is chlorodyne. Owing to the amount of morphine in chlorodyne, it is generally assumed that in cases of poisoning the pupils would be contracted. As a matter of fact, however, it has been recently pointed out by Powell, the police surgeon of Bombay, that in five recent cases met with by him the pupils were found widely dilated, owing to the not inconsiderable quantity of hydrocyanic acid used in these preparations.

Datura Poisoning.

Two species of datura are commonly found in India and the Malay peninsula, viz. *D. fastuosa* and *D. alba*. They are practically wild plants, growing by roadsides and in the fields all over India. *D. fastuosa* (Linn.) is a herbaceous plant, natural order Solanaceæ, about from 4 to 6 feet high, with widely spreading branches and conspicuous trumpet-shaped flowers. The fruit is an oblong globular capsule, 1½ inches (4 c.m.) in diameter, spinous, dehiscing into two halves containing a large number of seeds, the embryo of which has a characteristic curvation. The following distinction between datura and chillies is by J. D. Gimlette:—

> "In many instances the light colour and the pungent taste of the latter would be sufficient to make a distinction, but when either is cooked and mixed with food, such as boiled rice, recognition by means of the taste alone cannot be relied upon. The resemblance is most marked in the unripe seeds, but a careful comparison of the two kinds shows many morphological points of difference. The *Datura alba* seed is almost reniform in shape, having one end smaller than the other. It has been, not altogether fancifully, compared to the human ear, but the margin is angular; size about ¼ inch (5 millimetres) in length, rather less in width; no marked odour; taste slightly bitter; surface somewhat shrivelled except on the two compressed sides; testa tough and rough, being made up of a convoluted series of thick-walled cells, so arranged as to give a pitted appearance when seen with the lens. Datura seeds in powder may be distinguished by means of the cavernous appearance of their exosperm when seen under the microscope.
>
> "The embryo is embedded in a white oily albumen, and curved in a manner peculiar to the genus. By cutting parallel to the flattened side the embryo may be seen by the naked eye to be curved, twisted, and recurved, so as to resemble the head of a shepherd's crook.
>
> "A watery decoction of the datura seeds, when placed in the eye, will cause dilatation of the pupil.
>
> "The seed of the capsicum is kidney-shaped, a little shorter and wider than that of the datura, pale yellow in colour, uniformly rough, and when seen in section as described above, the embyro is found in a flesh albumen and curved like the figure 6. Capsicum seeds in powder may be recognised by means of the application of heat, the acrid vapours of capsicin being at once detected by heating even a small portion.
>
> "A watery decoction, when placed in the eye, causes irritation without dilatation of the pupil. The seeds of the *Datura fastuosa* resemble those of *Datura alba*. They are about ⅙ inch (4 millimetres) long, of an oblong kidney shape, flatter, and darker in colour. About eight of them weigh one grain in the dried state."

The use of datura is in a special degree an Indian method of poisoning. It is very seldom used for actual homicidal purposes, but owing to a widespread belief among the natives that it is a mere intoxicant, a fatal issue sometimes results from its liberal use.

It is usually given to produce a sufficient degree of insensibility to facilitate robbery and theft. The story told by the victims is almost always the same.

It is to the effect that a party of villagers are travelling along a road. Towards evening they are met by another party of presumed travellers. One or more of the new arrivals are dressed as Brahmins, or men of high and holy caste. They make themselves agreeable, and before dark the whole party settles down to camp out for the night. One of the robbers proposes that, as he is a Brahmin, he will do them the honour of cooking for the whole party. The compliment implied is too great to admit of any refusal, and the supposed Brahmin sets about preparing the evening meal of rice and pulses. In cooking he easily manages to add a quantity of datura seeds to the mess prepared for his victims. About half an hour after the food has been eaten the symptoms of poisoning appear, and soon result in a state of stupor and coma, during which the victims are helpless and easily robbed. When they come to their senses a few hours later the robbers are far away, and with them the valuables of the deceived travellers.

This form of poisoning for robbery has, to an almost complete extent, taken the place of the strangling method of the Indian thugs, or road robbers, of an older time. Datura poisoning is now almost altogether in the hands of professionals, and such are to be found all over India. Quite recently a gang was discovered at the Howrah railway station in Calcutta. They were headed by a native policeman, and they confined their operations to the watching and following of parties of native travellers alighting at lonely, out-of-the-way roadside stations.

The following two characteristic cases are quoted by Gimlette from his experiences in the Malay States. They show that the same method of mixing the seeds in the food is practised in Malay as in India:—

"*Case* 1. In the month of April, 1896, a Malay named Saiyed was charged at Kuala Lipis, Pahang, with causing hurt by means of poison. He pleaded not guilty, but although the motive of his crime was never actually discovered, he was eventually convicted of having mixed datura seeds in a curry, thereby stupefying a Malay constable, his wife, their niece, and a girl friend, as well as two men, all of whom happened to eat of the same dish. The symptoms in each case were similar, namely, attacks of giddiness, passing into unconsciousness for a few hours, followed by complete recovery. This group of cases is of some interest owing to the fact that one of my colleagues, who appeared for the prosecution, was able to give evidence of a very practical kind. A sample of seeds and powder which had been found in the prisoner's handkerchief was sent to Dr. D. H. McClosky for identification. I am indebted to him for the following notes of his personal experiment. He says: 'I took pinch doses of the sample, which consisted of the bruised seeds, and had the following experience: I felt flushed, dry about the mouth and throat, and became hoarse. When I tried to walk I staggered about like a drunken man and got very excited. I then took an emetic of zinc, vomited, and slept for about five or six hours.' Dr. McClosky is further said by an eyewitness to have been in a delirious state, rolling on the floor, and uttering inarticulate cries.

"*Case* 2. *Datura Seeds Mixed in Food by Pathans.*—In February, 1900, a Pathan was found by the roadside in Kuala Lipis, and brought to the hospital about midnight. He was half conscious, very restless, had dilated pupils, and was supposed to be intoxicated with alcohol. Mr. Henry Philips, the chief dresser, who saw him the next morning, fortunately suspected datura poisoning. He applied the stomach-pump, and found datura seeds, together with partially digested rice and green peas, in the gastric contents. The patient made a complete recovery, and two of his fellow-countrymen were subsequently sentenced to rigorous imprisonment for having administered the poison with intent to facilitate robbery."

The symptoms of datura poisoning are those of belladonna poisoning [*q.v.*, p. 684—Ed.]. When the seeds are given internally the professional thief seems to know the exact dose necessary. The symptoms of unconsciousness may commence early—within a quarter of an hour. The effect of the drug may last for two days, and is more severe, as a rule, if it is administered during childhood and old age. Many fatal cases of poisoning by the fruit and young seeds of datura are reported by Chevers, as well as five fatal cases of poisoning by the leaves. They are mostly in children and aged persons. Excessive dilatation of the pupil may be regarded as a dangerous symptom in datura poisoning. The loss of power of accommodation which is thereby produced, and the hallucinations caused, may explain the disorders of vision which are so common. There is also a certain degree of impairment of memory before complete recovery.

In India this after-effect has been regarded as one of the causes of insanity, and it seems not at all improbable that slow or chronic poisoning by datura would tend to weaken the intellect. In the absence of any suspicious circumstances, diagnosis may be difficult; cases have been confounded with rabies, delirium tremens, and mania.

There is some reason to believe that we possess an efficient antidote in permanganate of potash, which has the chemical property of oxidising some of the vegetable alkaloids. It has been used, with varying success, in cases of opium poisoning, and should be tried in a case of datura poisoning [*vide*, p. 763—Ed.].

The Cooaine Habit in India.

It is a suggestive and somewhat remarkable fact that lately the practice of eating cocaine has become widely prevalent in many parts of India, in fact to such an extent as to necessitate special legal measures for the control of the sale of this useful drug.

In spite of legal restrictions, the records of the police courts in Calcutta, as reported in the daily papers, show that almost every day one or more persons are prosecuted and heavily fined for selling cocaine without a licence.

I have elsewhere published a study of the cocaine habit as practised among the juvenile criminal classes in Calcutta. The drug is usually taken for its euphoric effects, mixed with *pan* and *betel* so commonly eaten as a masticatory by the natives of India. The cocaine is usually eaten in the form of the hydrochlorate, as used in ophthalmic practice. The dose is generally about one grain, and is repeated as often as the *habitué* is able to buy this expensive drug. It produces a temporary feeling of satisfaction and well-being, but is soon followed by a reaction which calls for repetition of the drug. Though I have seen individuals who claimed to be in the habit of eating as much as half a drachm a day, yet I am bound to say that in not less than one hundred cases in which, on admission to prison, the drug was immediately and certainly stopped, the symptoms of abstinence were slightly marked. Beyond a temporary depression and a hollow feeling in the abdomen there was little complained of. One distinguishing sign of the cocaine-eater (at least when it is eaten along with lime *pan* and *betel*) is an ebony blackness of the teeth, especially on their posterior aspects. This sign I had not seen mentioned anywhere before I first pointed it out.

The recent introduction of the cocaine habit suggests the view that if the efforts of the well-meaning opponents of what is called the "opium traffic" were successful, a new drug or narcotic would soon replace the use of opium with results at least as serious.

OTHER LESS COMMON POISONS.

The practice of camphor-eating has recently been reported as not uncommon in some native girls' schools in Calcutta. Giddiness and excitement, followed by a deep sleep, result from its excessive use.

Marking nut (vernacular *bhela*), the fruit of *Semicarpus Anacardium*.—This is rarely given internally. An "ink" is made from the acrid juice which is used in marking clothes. After marking the clothes it is necessary to damp the part in lime-water to neutralise the irritant, otherwise if it touches the skin it will give rise to a painful vesicular eczema-like inflammation. It has also frequently been used to fabricate bruises on the skin.

Madar (*Calotrophis gigantea*), a common weed all over India.—The leaves contain a white milky juice, which is acrid. The root has some traditional repute as a remedy for dysentery, instead of ipecacuanha.

The juice of madar is chiefly used as an abortifacient.

Physic nuts (*Jatropha Curcas*) [*vide* p. 740.—ED.].

The tuberous root of *Gloriosa Superba* is popularly believed to be poisonous. It is so only in large doses.

Cocculus Indicus, or Levant nut [*vide* p. 699.—ED.].—The shape of the nut on section is characteristic.

Lal chitra (*Plumbago Zelanica*) has been mentioned as an abortifacient. It can also be used to artificially produce bruises (Walsh, *Indian Med. Gaz.*, January, 1900).

Jequirity (*Abrus precatorius*).—An irritant to mucous membranes, chiefly used for cattle poisoning. The pounded seeds are made into a paste and dried on sharp points of bamboo. These poisoned points are inserted under skin of cattle. The animal dies, and the hide-dealers (*chamars*) buy the hide for a trifle.

Drs. Warden and Waddell, of Calcutta, showed that the poison of jequirity is *abrin*, which acts as a blood poison.

Warden recorded a case of poisoning by jequirity introduced beneath the skin of a man by means of a *sni*, or pointed stick above mentioned. Several similar cases of its homicidal use are on record.

Nux vomica and strychnine [*vide* p. 782.—ED.].—The use of this drug for poisoning is rare, and generally accidental, sometimes suicidal. Waddell (*Indian Med. Gaz.*, March, 1885) suggested that the mistaking of *Nux vomica* bark (*kuchila* in the vernacular) for the bark of *Holarrhena antidysenterica* (*kurchi*) might explain some of the great mortality attributed to tetanus in Calcutta.

White oleander (*Nerium odorum*), or "true oleander," is sometimes the cause of poisoning. Some cases are reported (*Indian Med. Gaz.*, 1901) by C. L. Bose, who has isolated three active principles: neriodorin, neriodorein, and karatin. The vernacular names of this plant are *kaner* and *karabi*. The symptoms somewhat resemble those of strychnine: twitchings, convulsions, spasms, vomiting, and unconsciousness.

Yellow or bastard oleander (*pilakaner* in the vernacular, *Cerbera theretia*).—This is commonly used for suicide and as an abortifacient. The symptoms are exhilaration followed by depression and paralysis. The peculiar triangular shape of the nut is characteristic.

Aconite [*vide* p. 664.—Ed.].—*A. ferox* is very common in the Himalayas, especially in the Sikkhim hills and on the road to Thibet. The long (3-inch to 4-inch) conical roots are known in the bazaars as *bish* or *bikh*. A decoction of the root is mixed with other liquor, and is thus used for poisoning.

Mechanical Irritants.

Such substances as pounded glass, diamond dust, and chopped hair come into consideration, not that they are strictly definable as "poisons," but because they are "unwholesome things" or "deleterious to the human body to swallow," in the words of the Indian Penal Code (321, 326).

Several cases are referred to in the reports of the chemical examiners. There were thirty-one such cases in ten years in Bombay. The injury inflicted on the mucous membrane of the alimentary tract will depend on the degree of fineness of the pounded glass. The glass is usually administered in sweetmeats or in vegetable messes mixed with rice, pulse, and spices.

Apart from the celebrated Baroda case, there are, naturally, not many cases on record of "poisoning" by diamond dust. In the Baroda case the diamond dust along with arsenious oxide was found in the remains of a cooling drink or *sherbat*.

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APPENDIX.

SYNOPSIS OF RECENT MEDICO-LEGAL LITERATURE.

(Originally compiled by Stanley B. Atkinson.)

(In selecting articles preference has been given to those with ample references.)

GENERAL REFERENCES.

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[1] These abbreviations refer to subsequent references.

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[1] These abbreviations refer to subsequent references.

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